FORESTRY

FRDA
HANDBOOK 006 [Revised]

Herbicide Field Handbook

ISSN 0835 1929

MARCH 2002

BRITISH COLUMBIA

103-06808/

HERBICIDE FIELD HANDBOOK

(REVISED)

by
Jacob O. Boateng

Forest Practices Branch,
B.C. Ministry of Forests
Victoria, B.C.

MARCH 2002

BRITISH COLUMBIA

Funding for this publication was provided by the British Columbia Ministry of Forests and Forest Renewal British Columbia (FRBC). The original version published in March 1990 was funded by the Canada-British Columbia Forest Resource Development Agreement - a five year (1985-1990) $300 million program cost-shared equally by the federal and provincial governments.

National Library of Canada Cataloguing in Publication Data
Otchere-Boateng, Jacob, 1942-
Herbicide field handbook (Revised)

FRDA handbook, ISSN 0835-1929 ; 006 [Rev.]

Rev. ed.
Previously publ.: Ministry of Forests, 1998.
ISBN 0-7726-4749-6

1. Herbicides - British Columbia - Handbooks, manuals, etc.
I. British Columbia. Ministry of Forests. II. Title. III. Series.

SB951.4.082 2002 632'.954'09711 C2002-960073-1

© 1990, 1998, 2002 Province of British Columbia

Produced by the Ministry of Forests.
Forest Practices Branch.

To purchase hard copies of publications please order from:
Government Publications Centre
2nd Floor 563 Superior St.
Victoria, B.C. V8W 9V7
FAX (250) 387-1120
PHONE 1-800-663-6105
Local (250) 387-6409
http://www.publications.gov.bc.ca

ACKNOWLEDGEMENTS

The author greatly acknowledges the assistance of Heather Williams (Victoria) in the preparation of this handbook. Formatting of the material for publication was done by Gini Pitzer of Victoria.

Support for the publication of the original version of this handbook was provided by the Canada-British Columbia Forest Resource Development Agreement FRDA I - a five year (1985-90) $300 million program cost-shared equally by the federal and provincial governments. Funding for the current revised Herbicide Field Handbook was provided by the British Columbia Ministry of Forests and Forest Renewal British Columbia (FRBC). Funding assistance by FRBC does not imply endorsement of any statements or information contained in the handbook.

DISCLAIMER

Sources of Information for this handbook include labels, material safety data sheets and publications of herbicide and equipment manufacturers.

The use of products, trade or manufacturer's names in this publication does not constitute an official endorsement or approval by Forestry Canada, B.C. Ministry of Forests or the author of any product or service to the exclusion of any others that may also be suitable.

TABLE OF CONTENTS

SECTION A:
HERBICIDE PRESCRIPTION FOR FOREST VEGETATION MANAGEMENT

Decision Making Profile for Forest Vegetation Management A-1
Herbicide Prescription Checklist: Forest Vegetation Management Treatments A-3
Registered Forestry Herbicides in Canada A-5
Application Methods and Techniques for Registered Forestry Herbicides A-8
Herbicide Treatment Injury: Conifers in B.C. A-13
Herbicide Treatment Effectiveness: Hardwoods in B.C. A-14
Herbicide Treatment Effectiveness: Shrubs, Grasses, Ferns and Forbs in B.C. A-15
Comments Regarding Treatment Effectiveness of Selected Herbicides A-19

SECTION B:
INFORMATION ON HERBICIDE PROJECT IMPLEMENTATION

Herbicide Project Checklist B-1
Application Equipment and Supplies Checklist B-3
Examples of Dyes for Monitoring Herbicide Application B-3
Herbicide Project Pre-Work Conference: Checklist B-4
Weather Conditions Limiting Herbicide Broadcast Spraying B-6
Recommended Time and Conditions for Aerial Spraying B-7
Reducing Off-Target Deposition and Spray Drift Potential B-8

SECTION C:
EQUIPMENT CALIBRATION AND RELATED INFORMATION

Backpack and Power Operated Ground Sprayer Calibration C-1
Aerial Sprayer System Calibration Checklist C-2
Selecting the Number of Nozzles for Broadcast Application C-4
Some Calculations Relating to Aerial Spray System Calibration C-5
Spray Area Computation Table of Aircraft Speed and Swath Width C-7
Spray Area Computation Table of Swath Length and Width C-8
Suggested Spray Nozzles and Tips C-9
Herbicide Spray Patterns: Aerial Application Nozzles Used in B.C. C-10
Herbicide Spray Pattern Evaluation Based on Efficacy C-11

SECTION D:
PROJECT MONITORING AND EFFECTIVENESS EVALUATION

Herbicide Project: Operation Record Keeping D-1
Herbicide Project: Monitoring Checklist for Herbicide Treatment Activities D-3
Post-Treatment Evaluation: Treatment Effectiveness Checklist D-4

TABLE OF CONTENTS *(CONTINUED)*

SECTION E:
FIRST AID AND PERSONAL PROTECTIVE GEAR: FOR HERBICIDE USE

First Aid Kit: Herbicide Use E-1
General First Aid Procedures for Herbicide Use E-2
Exposure to Selected Herbicide Products: Specific First Aid Instructions E-3
Symptoms of Exposure to Selected Herbicides E-5
Recommended Types of Protective Clothing and Equipment for Herbicide Use E-5
Minimum Personal Protective Clothing and Equipment for Herbicide Operations E-7
Cleaning Recommendations: Personal Protective Clothing and Equipment E-9
Procedure for Laundering Herbicide Contaminated Clothing E-10

SECTION: F
HERBICIDE USE SAFETY PRECAUTIONS: MIXING, APPLICATION, STORAGE, TRANSPORTATION AND CONTAINER DISPOSAL

Herbicide Use Safety: General F-1
Herbicide Use Safety: Mixing of Herbicides F-2
Incompatibility of Selected Herbicides with Specific Materials F-3
Herbicide Use Safety: Herbicide Application F-4
Herbicide Use Safety: Storage of Herbicides F-6
Shelf Life of Some Herbicides F-7
Herbicide Use Safety: Transportation of Herbicides F-8
Shipping Information for Some Selected Herbicides F-9
Handling and Disposal of Unused Herbicides and Empty Herbicide Containers F-11
Herbicide Use Safety: Cleaning and Storage of Spray Equipment F-12

SECTION: G
HANDLING EMERGENCY SITUATIONS: PREPARING AND RESPONDING TO EMERGENCIES

Developing a Plan for an Emergency: Checklist G-1
Emergency Response Services, Government Agencies and Company Contacts G-2
Other People or Agencies to Notify in Case of an Emergency G-3
Procedure for Notifying Emergency Response Agencies G-4
Basic Procedures for Handling Herbicide Poisoning, Spills and Fires G-4
- Handling Herbicide Poisoning G-4
- Handling Herbicide Spills and Leaks G-4
- Herbicide Spill Kit G-4
- Procedure for Handling Herbicide Spills and Leaks G-5
- Handling Herbicide Fires G-5
- References G-5

Fire Protection/Fire Fighting Information for Selected Herbicide Products G-6

SECTION H
TABLES OF CONVERSION UNITS

Conversion Factors H-1
Units of Equivalents H-3

SECTION A

HERBICIDE PRESCRIPTION FOR FOREST VEGETATION MANAGEMENT

DECISION MAKING PROFILE FOR FOREST VEGETATION MANAGEMENT

ADMINISTRATION AND TREATMENT AREA IDENTIFICATION	
Region	Opening No./Map Reference
District	Licensees
Location	Biogeoclimatic Zone/Subzone
Other	Vegetation Complex

DECISION MAKING PROCESS A. State Treatment Objective(s):	Selected Objective(s)
• Pre-harvest vegetation control • Site Preparation • Crop seedling establishment and growth • Growth enhancement of crop tree seedling • Free growing stand • Habitat enhancement • Forest range improvement • Forest road access • Aesthetics • Other	1. 2. 3.
B. Select 3 Potential Options	**Selected Options to Evaluate**
• Biological, e.g. Sheep grazing • Prescribed burn • Aerial Herbicide Application • Ground Herbicide Spraying • Herbicide Bark Treatment • Herbicide Spot Treatment • Herbicide Stem/Root Injection • Herbicide/ Prescribed Burn • Mechanical Method • Mechanical/Prescribed Burn • Physical: e.g., Manual Cutting, Girdling, • Mulching • Cover Crops: Grass/Legume Seeding • Other	1. 2. 3.
C. Evaluation: Examples of Items to Consider	**Evaluation Comments**
1. Biological Effectiveness • Short-term objective: treatment effectiveness • Long-term objective: e.g. free growing stand • Injury to crop trees, desirable vegetation • Vegetation control intensity and duration • Potential for multiple treatments • Other	1. 2. 3.
2. Environmental Impact: Site Resources • Long-term soil disturbance • Major vegetation shifts • Forest health impact • Water and air quality • Wildlife habitat changes • Wildlife displacement • Carnivore interaction with domestic animals • Fisheries resources • Forest range resources • Recreational Resources: aesthetics	1. 2. 3.

DECISION MAKING PROFILE FOR FOREST VEGETATION MANAGEMENT
(CONT.)

C. Evaluation: Examples of Items to Consider	Evaluation Comments *(Continued)*
3. Suitability or Ease of Use of Option on the Site • Accessibility to the site • Trafficability for workers and equipment: • Slope and terrain • Site obstructions: snags, rock outcrops • Soil sensitivity • Vegetation type, density and height • Streams and other water courses • Closeness to human habitation or other "sensitive" sites	1. 2. 3.
4. Worker and Public Safety: Safety of the Option • Potential Injury to workers on site • Potential Injury to people nearby	1. 2. 3.
5. Vegetation Management Costs • Single-entry treatment costs • Multiple treatment costs to achieve objective(s)	1. 2. 3.
6. Total Cost Consideration of all Activities Required to Achieve Objective(s), e.g. Free Growing • Site preparation • Planting (including fill planting) • Brushing • Forest Health	1. 2. 3.
7. Economic, Social and Cultural Impacts • Community stability • Potential public or interest groups concerns • Cultural heritage sites	1. 2. 3.
8 Other Items	
EVALUATOR'S TREATMENT OPTION SELECTION AND RATIONALE	**MANAGEMENT'S RECOMMENDATION AND RATIONALE**
Name Signature Position Date	Name Signature Position Date

HERBICIDE PRESCRIPTION CHECKLIST: FOREST VEGETATION MANAGEMENT TREATMENTS – A TWO STEP PROCESS

Step A. Selecting the Appropriate Vegetation Management Strategy and Treatment Options

1. Site Survey and Assessment of the Need for Vegetation Management
   (Have Knowledge of Autecology of Crop Trees, Browse Species and Competing Vegetation Species On-site and Adjacent Areas)

- Establish/Predict the Nature of Vegetation Problem on the Site/Area
  - Prepare List of Crop Trees (where applicable)
  - Prepare a List of Wildlife Browse Species
  - Prepare a List of Target (Competing or Undesirable) Vegetation
  - State Size (Height, Diameter), Abundance, Distribution and Vigour of Target Vegetation
  - Determine Presence of Undesirable Seed Sources on Adjacent Areas and
  - Potential Problems Following Harvesting or Regeneration Activities

- Evaluate the Site/Area and its Characteristics
  - Site History, including: Previous Harvesting and Reforestation Activities and Techniques; Site Disturbances
  - Other Planned Future Activities for the Site/Area
  - Soils and Properties
  - Importance to Fisheries, Wildlife and Range Resources
  - Sensitivity of the Site/Area: Closeness to Human Habitation, Water Resources, etc.
  - Social Issues in the Area that can affect Use of the Options
  - Cultural Heritage Importance

2. Evaluate the Survey/Assessment Results in terms of the Current and Expected Impact of the Target Vegetation on Crop Trees and Reforestation: Impact of not Managing the Vegetation

3. Choose a Vegetation Management Strategy
   - "No Treatment" Strategy
   - Prevention Strategy
   - Early Treatment Strategy
   - Maintenance Strategy
   - Correction Strategy

4. State Treatment and Management Objectives
   - Pre-harvest Vegetation Management (e.g., for future Vegetation Management Problem Prevention)
   - Preparing Site for Reforestation
   - Ensuring/Improving Survival and Establishment of Crop Tree Seedlings
   - Enhancing Growth of Crop Tree Seedlings
   - Promoting Prompt and Timely Achievement of a Free Growing Stand (Reforestation/Silviculture Objective)
   - Providing Forest Road Access
   - Improving Wildlife Habitat
   - Improving Forest Range Lands
   - Improving Recreational Areas

5. Select the most Appropriate Vegetation Management Treatment Option for the Site.
   This should be based on a Documented Decision-Making Process which must during the selection process include consideration and evaluation of the Site Characteristics, Management Objectives and all the available Vegetation Management Options and their impacts.

Specific factors to consider include:

- Effectiveness: Treatment Efficacy, and meeting Reforestation Objectives
- Operational Suitability of the Methods on the Site/Area:
  - General Accessibility of the Site/Area
  - Difficulty of Using Workers and the Methods (e.g. Machinery) on the Site
- Treatment Impact on People and the Environment
  - Human Safety and Human Health
  - Cultural Resources
  - Physical and Biological Considerations

HERBICIDE PRESCRIPTION CHECKLIST: FOREST VEGETATION MANAGEMENT TREATMENTS – A TWO STEP PROCESS *(CON'T)*

- Effect on Crop Trees: Crop Tree Damage
- Effect on Fish, Wildlife and Habitat
- Effect on Vegetation, Air Quality, Water and Soil Resources
- Range Resources
- Recreational (e.g., Visual) Resources

- Cost-Effectiveness:
  - Cost per ha for the Treatment under Consideration
  - Total Cost per ha for Expected Multiple Vegetation Management Treatments to Achieve Objective
  - Total Reforestation Cost per Hectare
- Social/Cultural Impacts

Step B. Where the Herbicide Treatment Option is chosen, continue as follows:

1. Have knowledge of the Registered and Available Herbicides
   - Herbicide Label and Use Restrictions
   - General Properties: Safety and Handling; Application Rates and Season/Methods and Techniques of Application
   - Impact on Crop Trees
   - Effectiveness/Efficacy on Target Vegetation
   - Impact on the Environment and other Resources

2. Evaluate the Target Species with the Available Herbicides and Treatment Techniques. Prepare a Worksheet as a Guide
   - List Target Vegetation Species with Candidate Herbicide Treatments (including Rates, Techniques and Timing)
   - State Expected Target Vegetation Control of each Candidate Herbicide Treatment
   - State Expected Damage to Crop Trees by the Candidate Herbicide Treatments
   - Rank Results of the Evaluation
3. Select the appropriate Herbicide, Treatment Technique and Timing that will best meet Treatment and Reforestation Objectives, Concerns for Human Safety, the Environment and Cost-effectiveness. The selection process should include consideration of the following:
   - Efficacy: Degree of Control Desired to Achieve Treatment Objectives
   - Injury to Crop Trees
   - Ease of Handling and Application of the Herbicide
   - Suitability of the Application Technique for Use on the Specific Site/Area
   - Impact on on-site Workers
   - Impact on People Nearby
   - Impact on the Environment and other Resources including
     - Fish and Wildlife, and their Habitats
     - Water Resources
     - Recreational Resources
     - Range Resources
   - Treatment Cost

4. Prepare a Pest Management Plan or Permit Application for Herbicide Use: Submission and Approval

5. Implement the Herbicide Treatment; include Project Monitoring

6. Evaluate the Herbicide Treatment Effectiveness (Efficacy)

7. Examine and Evaluate the Success of the Prescription in Achieving Management Objective(s). For example, Reforestation or Silviculture objective of achieving a free-growing stand

Notes:

REGISTERED FORESTRY HERBICIDES IN CANADA

Herbicide (Common Name)	Product Examples (Manufacturer) PCP No. ◆	Product Form ■	Guarantee %*	Type of Registration ▲	Target Vegetation Group	Uptake Route ●	Application Method ▼
Asulam	Asulox F (Rhone-Poulenc Canada Ltd) 11341	SN	40	W (SP,CR)	Bracken fern	Foliage	G
Glyphosate	Vision® (Monsanto) 19899	SN	35.6	F (SP, CR)	Annual and perennial weeds, woody plants	Foliage, cut surfaces	G, A CS, I
	Forza ™ (Cheminova) 26401	SN	36	F (SP, CR)	Annual and perennial weeds, woody plants	Foliage, cut surfaces	G, A CS, I
	Vantage® Forestry (Dow Agro Sciences) 26884	SN	35.6	F (SP, CR)	Annual and perennial weeds, woody plants	Foliage, cut surfaces	G, A, CS, I
	EZJect® Herbicide Capsules (Odom Industries, USA) 21262	CP	83.5[a]	F (SP,CR,CT)	Woody brush and trees	Stems, root crowns Cut (stump) surfaces	I, RI
Chondrosterium purpureum (HQ1)	Myco-Tech™ Paste (Myco-Forestis Corporation)	Paste	9.1	** CR	Broadleaf trees	Cut surfaces	CS
Hexazinone	Velpar® L (Dupont) 18197	SN	24*	W (SP, CR)	Annual, biennial and perennial weeds and grasses; hardwoods	Foliage, Roots	G, A ST
	Pronone® 10G (Dupont) 21390	GR	10*	W (SP)	Grasses and herbaceous species woody deciduous plants	Roots	G, ST

REGISTERED FORESTRY HERBICIDES IN CANADA *(CONTINUED)*

Herbicide (Common Name)	Product Examples (Manufacturer) PCP No. ♦	Product Form ■	Guarantee %*	Type of Registration ▲	Target Vegetation Group	Uptake Route ✖	Application Method ▼
MSMA	Glowon® (United Agri Products) 10892	SN	32[b]★	F (CT)	Conifers	Cut surfaces	I
Simazine	Clean Crop Simazine 80W United Agri Products 17697	WP	80	W (SP,CR)	Grasses, broadleaved and germinating plants	Roots	G
	Princep Nine-T® (Novartis) 16370	GR	89	W (SP,CR)	Grasses, broadleaved and germinating plants	Roots	G
2,4-D amine	Formula 40®F (Dow AgroSciences) 16994	SN	47	F (SP, CR)	Alder and willow	Cut surface, foliage	CS, I
2,4-D ester	Esteron® 600 (Dow AgroSciences) 15981	EC	56.4	F (SP,CR)	Shrubs, broadleaved forbs, hardwood trees	Stem, foliage, cut surface	G, A CS, I, B
	2,4-D Ester LV 600® (Nufarm Agriculture Inc.) 14739	EC	56.4	F (SP,CR)	Shrubs, broadleaved forbs, hardwoods	Foliage	G,A
	2,4-D Ester 600 (United Agri Products) 9561	EC	56.4	F (SP,CR)	Shrubs, broadleaved forbs, hardwoods	Stem, foliage, cut surface	G, A CS,I,B
	For-Ester® (United Agri Products) 16675	EC	47	F (SP, CR)	Shrubs, broadleaved forbs, hardwoods	Stem, foliage, cut surface	G, A CS, I, B
	2,4-D LV 600® (Dow AgroSciences) 9560	EC	56.4	F (SP,CR)	Shrubs, broadleaved forbs, hardwoods	Foliage	G,A

REGISTERED FORESTRY HERBICIDES IN CANADA *(CONTINUED)*

Herbicide (Common Name)	Product Examples (Manufacturer) PCP No. ◆	Product Form ■	Guarantee %*	Type of Registration ▲	Target Vegetation Group	Uptake Route ✖	Application Method ▼
2,4-D ester+ 2,4-DP ester	Weedone® CB (Nufarm) 19780	EC	8 + 8	F (SP,CR)	Woody plants	Stem, cut surface I, B	G, CS
Triclopyr[c]	Release® (Dow AgroSciences) 22093	EC	48	F (SP,CR,CT)	Shrubs and broadleaved forbs, hardwoods	Stem, foliage, cut surface	G, A CS,B
Picloram[d]	Tordon® 22K (Dow AgroSciences) 9005	SN	24	R	Noxious weeds: knapweed, field bindweed, leafy spurge, Canada thistle, etc.	Foliage	G,ST

Notes:

◆ PCP No. is the Registration Number under the Pest Control Product Act (Canada).

★ Where indicated by ★, guarantee % is in active ingredient (a.i.). All others are in acid equivalent (a.e.).

** Granted a one-year limited term registration by the PMRA (Jan. 4 2002) for use east of the Rockies.

✖ Based on methods of application.

[a] 83.5% glyphosate or 0.15 g glyphosate per capsule.

[b] As elemental Arsenic: equivalent to 44.9% MSMA

[c] Garlon 4® in the USA is Release® in Canada

[d] Registered only for use on forest rangeland, not for silviculture.

■ Product Form:
CP = Capsulated Paste
EC = Emulsifiable Concentrate
GR = Granular
SN = Solution
WP = Wettable Powder

▲ Type of Registration:
F = Forest Management Registration Treatment site can be > 500 ha
W = Woodland Registration Treatment site cannot be >500 ha
S = Site Preparation
CR = Crop Release (Crop Establishment and Growth)
CT = Conifer Thinning
R = Rangeland

▼ Application Method:
A = Aerial broadcast
G = Ground Broadcast
B = Basal (Stem, Bark)
I = Stem Injection/Frill
CS = Cut Stump Application
ST = Spot
RI = Root Injection

Source: Product Manufacturers' labels

APPLICATION METHODS AND TECHNIQUES FOR REGISTERED FORESTRY HERBICIDES

Method	Herbicide	Technique
Aerial Foliar Broadcast Spraying (Helicopter, Fixed-Wing Aircraft)	Vision® (glyphosate)	**Site Preparation and Crop Release (Crop Establishment and Growth):** 3-6 L/ha Vision® in clean water to make a total volume of 30-100 L/ha. Higher volume for dense or multi-level vegetation. Average droplet size (or VMD) 250-500 micron diameter. For crop treatment of summer-planted spruce species in the same year: 2-6 L/ha Vision® in clean water to make a volume of 30-100 L/ha for use after 18 days following planting on forest site.
	Esteron® 600 For-Ester® 2,4-D LV 600® Nufarm 2,4-D Ester LV 600® *(2,4-D ester)*	**Site Preparation:** 5.5-8.5 L/ha Esteron® 600, 2,4-D LV 600®, Nufarm 2,4-D Ester LV 600® or 6.6-10.2 L/ha For-Ester® in 30-100 L/ha spray mixture. Carriers: water, oil, oil-water mixture; 10% oil solution best. Avoid spraying after prolonged dry period. **Crop Release (Crop Establishment and Growth):** 4.25-5.5 L/ha Nufarm 2,4-D Ester® LV 600, 2,4-D LV 600®, Esteron® 600 in 30-80 L/ha total spray mixture. Use water or oil-water mixture. For dormant treatment (early spring) in B.C., use 4.75-5.5 L/ha Esteron 600® with oil to make a total volume of 30-80 L/ha spray mixture.
	Velpar® L *(hexazinone)*	**Site Preparation:** 9-18 L/ha Velpar L® in a minimum of 35 L water/ha.
	Release® *(triclopyr ester)*	**Site Preparation:** 3-6 L/ha Release® (or 3-4 L/ha in case of Jack pine) with water in a minimum of 30 L total spray mixture per ha.
Basal Bark Treatment	Release® *(triclopyr ester)*	**Site Preparation, Crop Release (Crop Establishment and Growth), Thinning:** • Conventional Volume (<15 cm basal diameter): 5 L in oil to make 100 L of mixture. Treat lower 50 cm of stem including root collar area. • One side low volume (<15 cm basal diameter): 20-30 L in oil to make 100 L of mixture. Treat lower 30 cm including root collar area. • Thinline (<15cm basal diameter): Treat lower 15 cm from ground with undiluted product. • Streamline: mix 20-30 L in oil to make 100 L. Treat stem 30-50 cm of from ground level.

* Note: Dow AgroSciences, manufacturer of Release®, recommends ISOPAR M or any other isoparaffinic mineral oil as a diluent. Canola oil is the recommended diluent when termperature > 24° C. Diesel oil is not recommended.

APPLICATION METHODS AND TECHNIQUES FOR REGISTERED FORESTRY HERBICIDES *(CONT.)*

Method	Herbicide	Technique
	Esteron 600® For-Ester® *(2,4-D ester)* Weedone® CB *(2, 4 DP)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Use 3% herbicide oil* solution of 2,4-D ester or full strength Weedone® CB. Treat stems to a height of 50 cm from the ground.
Grid Spot Application	Velpar L® *(hexazinone)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Apply 9-18 L full strength Velpar L® per ha using a spot gun in a 1 x 1 m to 2 x 2 m grid pattern (25-10 000 spots/ha). Direct application to soil. Lower rates for soils low in organic matter and clay. Spot should be placed 1 m from stem of desirable trees. For single stem treatment apply Velpar L® at 0.75-1.5 ml for each 1 cm of stem diameter. Direct treatment to the soil within 0.5 m of root collar of plants to be controlled.
Ground Foliar Broadcast Spraying: Handheld and high volume equipment (e.g. backpacks)	Vision® *(glyphosate)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** 3-6 L Vision® in 100-300 L/ha of clean water or 1-2% solution using hand-held high volume equipment. For control of perennial herbaceous vegetation apply 7-12 L/ha (site preparation only). Use 2-6 L/ha Vision® for crop release of summer-planted spruce species in the same year (≥18 days following planting on forest site).
	Velpar L® *(hexazinone)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** 9-18 L/ha Velpar L® in water. Use at least 5 L of water for each litre of Velpar L® to prepare spray solution.
	Release® *(triclopyr ester)* Asulox F *(asulam)*	**Site Preparation:** 3-8 L Release® in water to make 100 L/ha of spray mixture. **Crop Release:** 3-6 L/ha Release® (or 3-4 L in case of Jack Pine) in at least 100L/ha total spray volume. **Salal Control:** 8 L/ha Release® in an oil carrier to make 100 L/ha of spray volume. **Bracken Fern Control:** 5.5 L/ha Asulox F in 200 L of water. Treat at or just before "Full Frond" but before the fronds turn brown. (Control not seen in the treatment year.)

APPLICATION METHODS AND TECHNIQUES FOR REGISTERED FORESTRY HERBICIDES *(CONT.)*

Method	Herbicide	Technique
Ground Broadcast Spraying: Granular Herbicide Applicators (e.g. Granulair Applicator)	Pronone 10G® (hexazinone)	**Site Preparation:** Apply 20 to 40 kg/ha of Pronone 10G, uniformly on the soil surface. Lower rate: medium textured soils. Higher rate: fine textured soils or soils high in organic matter, and for hard-to-kill species. Do not use on gravelly, rocky, sandy, coarse textured or frozen soils, waterlogged sites or sites with water table close to the surface.
Ground Foliar Broadcast Spraying: Vehicle-Mounted Sprayers	For-Ester® Esteron 600® *(2, 4-D Ester)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** 5-8 L/ha Esteron 600® (or 6-9 L For-Ester®) in water to make 1000 L solution per ha (e.g. Power-operated sprayers and hand guns. Well developed foliage. Avoid spraying after prolonged dry period) Good coverage: spray to runoff. *Vegetation should be <2.5m tall.*
	Vision® *(glyphosate)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** 3-6 L Vision® in 100-300 L/ha of clean water or 1-2% solution using hand-held high volume equipment. For control of perennial herbaceous vegetation apply 7-12 L/ha (site preparation only). Use 2-6 L/ha Vision® for crop release of summer-planted spruce species in the same year (≥18 days following planting on forest site).
	Velpar L® *(hexazinone)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** 9-18 L/ha Velpar L® in water. Use at least 5 L of water for each litre of Velpar L® to prepare spray solution.
	Release® *(triclopyr ester)*	**Site Preparation:** 3-8 L Release® in water to make 100 L/ha of spray mixture. **Crop Release:** 3-6 L/ha Release® (or 3-4 L in case of Jack Pine) in at least 100L/ha total spray volume. **Salal Control:** 8 L/ha Release® in an oil carrier to make 100 L/ha of spray volume.

APPLICATION METHODS AND TECHNIQUES FOR REGISTERED FORESTRY HERBICIDES *(CONT.)*

Method	Herbicide	Technique
Hack-and-Squirt, Frill or Injection (e.g. EZ-ject)	Formula 40F® *(2, 4-D amine)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** For trees > 15 cm dbh make complete frill. Trees < 15 cm dbh make one notch for every 3 cm dbh. All notches should angle downwards to hold herbicide solution. Add 1 mL undiluted 2,4-D amine product or up to 2:1 dilution per notch. For frill, add sufficient herbicide solution but ensure that there is no runoff. Use full strength for trees > 15 cm dbh.
	Vision® *(glyphosate)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Apply 0.5 mL of undiluted Vision® product or 1 mL 50% diluted product (i.e. 1:1herbicide:water dilution) for every 5 cm dbh cut. Tree > 20 cm dbh may not be controlled.
	Esteron 600® *(2, 4-D ester)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Treat freshly cut frill with 3% oil solution (30 L Esteron 600® herbicide in 1000 L oil).
	Glowon® *(MSMA)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** For conifers < 15 cm with full crown, cut a frill for every 2.5 cm dbh and apply 1 mL Glowon® per cut. Those with 1/2 or less complete crown apply 1 mL for every 5 cm dbh cut. Overlapping frill required for full crown large trees.
	EZ-ject® *(glyphosate capsules)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Apply one capsule for each 5 cm dbh of tree stem or cut stump. Stems or stumps should be >3 cm dbh to withstand injection pressure. Capsules should penetrate the bark into the cambium layer.

APPLICATION METHODS AND TECHNIQUES FOR REGISTERED FORESTRY HERBICIDES *(CONT.)*

Method	Herbicide	Technique
Cut Stump Treatment	Formula 40F® *(2, 4-D amine)* Vision® *(glyphosate)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Cut stem close to ground (< 50 cm from ground) with brush saw or chainsaw. Apply 2, 4-D amine product or Vision® immediately to freshly cut stumps and stubs using brush or sprayer with full strength or up to 2:1 water:herbicide dilution. Ensure coverage of the cambial layer.
	Release® *(Triclopyr ester)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Mix 20-30 L Release® in oil to make 100 L mixture. Treat the outer portion of cut surface, especially the cambium of stumps, and root collar. Immediate treatment not required.
	Esteron 600® *(2,4-D ester)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Mix 30 L Esteron 600® in 1000 L diesel oil, fuel oil or kerosene. Apply to the freshly cut surface. Ensure coverage of cambial layer.
	Weedone® CB *(2,4-D and 2,4-DP)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Apply full strength Weedone® CB to cut stump. Immediate treatment not required.
Wick or Wiper Applications (e.g. Roll-a-Wick by DexTRAC)	Vision® *(glyphosate)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Mix 1 L Vision® in 2 L water (33% solution) and apply on target vegetation foliage or cut stump. Ensure coverage of the cambium layer with the wiper/wick applicator. Very susceptible species maybe controlled with 10% Vision® solution.
	Release® *(triclopyr ester)*	**Site Preparation and Crop Release (Crop Establishment and Growth):** Mix 30 L Release® to make 100 L solution (30% solution) and apply to lower portion of stem bark and cut-stump surface. For cut stumps, ensure coverage of the outer portions of cambium layer.
Main sources: Compiled from herbicide manufacturers' labels.		

HERBICIDE TREATMENT INJURY: CONIFERS IN B.C.

Injury: *0=no visible injury; 1=<25% (light); 2=25-60% (moderate); 3=60-90% (severe); 4=90-100% (very severe); blank=unknown*

Treatment Period (TP): *BB=Bud break; new leaves; LF=Late Foliar, leaves fully expanded; EF: Early foliar; leaves 1/3 mature size; LS=Late summer, leaves fully mature + terminal growth completed; D=Dormant, winter before bud break or no decidious leaves; AS= All Season*

Herbicide	Rate	TP	Amabilis fir	Grand fir	Sub-alpine fir	Western redcedar	Douglas-fir	Western hemlock	Lodgepole pine	Ponderosa pine	Western white pine	Engelmann spruce	Sitka spruce	White spruce
Foliar applications														
2,4-D ester	2-3 kg ae/ha	EF		2			1	1		4			0	1
		LF		2		2	3	1		3	2		2	0
		LS	1	2-3			2-3	3	0	1-2	1-2		0	0
		D					0	0					0	0
Glyphosate	1.5-2.1 kg ae/ha	LF		3			1	2		3	3	1		0
		LS		2		2	1		0	0	2-3	0	0	0
		D		0						0	1	1		0
Hexazinone	1-2 kg ai/ha	EF					1		0		1			1
	2-4 kg ai/ha	EF or LF		1		2-3	2	0	0	1	2	2		1-2
		D		0			2		0	0				0
	4-8 kg ai/ha	EF or LF				3	2	1	1					2
Triclopyr ester	1-2 kg ae/ha	EF		1			2	1		4	3		1	
		LF		3			3			3	2			1
		LS - D		1			1	1		3			1	1
	2-4 kg ae/ha	LS - D					2-3	3		3			2	1-2
Soil applications														
Hexazinone	1-2 kg ai/ha	AS		1	0		1	0	0			0		1
	2-4 kg ai/ha	AS			2		2-3	0	1-2	0	1	1		1
	4-8 kg ai/ha	AS			2			0	2			2		2
Cut-stump applications														
2-4,D amine	30-100%	AS		4	4				4	4	4			4
Glyphosate	30-100%	AS		4	4	4	3	4	4	4	4	4	4	4
Triclopyr ester	20-30%	AS		4	4	3	3	4	4	4	4	4	4	4
Stem injection														
Glyphosate	1 Cap/5 cm dbh	AS	4	4	4	4	3	4	3	4	4	4	4	4
Basal Bark Treatment														
Triclopyr ester	3-5%	AS	4	4	4	4	3	3	4	4	4	4	4	4

HERBICIDE TREATMENT EFFECTIVENESS: HARDWOODS IN B.C.

Injury: *0=no visible injury; 1=<25% (light); 2=25-60% (moderate); 3=60-90% (severe); 4=90-100% (very severe); blank=unknown*

Treatment Period (TP): *BB=Bud break: new leaves; LF=Late Foliar, leaves fully expanded; EF: Early foliar: leaves 1/3 mature size; LS=Late summer, leaves fully mature + terminal growth completed; D=Dormant, winter before bud break or no decidious leaves; AS= All Season*

Herbicide	Rate	TP	Red alder	Trembling aspen	Paper birch	Black cottonwood	Bigleaf maple	Balsam poplar
Foliar applications								
2,4-D ester	1-2 kg ae/ha	EF or LF	4	2	2	0	1	0
	2-3 kg ae/ha	EF or LF	4	3	3	1	2	1
Glyphosate	1.5-2.1 kg ai/ha	LS	2	2-3	3	3	2-3	2-3
Hexazinone	1-2 kg ai/ha	EF		1	1		1	2-3
	2-4 kg ai/ha	EF or LF		2-3	2	2	1	2-3
	4-8 kg ai/ha	EF		3-4	3	3		3-4
Triclopyr ester	1-2 kg ae/ha	EF - LS	3	2				
	2-3 kg ae/ha	EF - LS	3-4	3-4	2-3	2-3	2-3	1-3
	4-5 kg ae/ha	EF - LS	4	4	4		3	
Soil applications								
Hexazinone	1-2 kg ai/ha	AS		0	1			
	2-4 kg ai/ha	AS	1	3	2-3		1	4
	4-8 kg ai/ha	AS		4	3			4
Cut-stump applications								
2-4,D amine	30-100%	AS	4	4	4	3	2	3
Glyphosate	30-100%	AS	4	3	3	4	3-4	
Triclopyr ester	20-30%	AS	4			4	4	
Stem injection								
2,4-D amine	1ml/5 cm dbh	AS	4	4		3		
Glyphosate	1 Cap/5 cm dbh	AS	4	4	4			4
Hack and squirt								
2,4-D amine	1ml/5 cm dbh	LF	4	2		3		
Glyphosate	1ml/5 cm dbh	EF or LS	4	3-4	4			4
Bark Treatment								
2,4-DP ester	100%	AS					1-2	
2,4-DP ester + 2,4-D ester	100%	AS					1	
Triclopyr ester	1-2%	AS	3				1	
	3-5%	AS	4			4	3	
	10-30%	AS	4	4	4		4	
	100%	AS	4				4	

HERBICIDE TREATMENT EFFECTIVENESS: SHRUBS, GRASSES, FERNS, AND FORBS IN B.C.

Injury: *0=no visible injury; 1=<25% (light); 2=25-60% (moderate); 3=60-90% (severe); 4=90-100% (very severe); blank=unknown*

Treatment Period (TP): *BB=Bud break: new leaves; LF=Late Foliar, leaves fully expanded; EF: Early foliar: leaves 1/3 mature size; LS=Late summer, leaves fully mature + terminal growth completed; D=Dormant, winter before bud break or no decidious leaves*

Herbicide	Rate	TP	Mountain alder	Sitka/green alder	False azalea	Scotch broom	Bitter cherry	Highbush cranberry	Stink currant	Devil's club	Red-osier dogwood	Elderberry	Dull Oregon grape	Hardhack	Black huckleberry	Red huckleberry	Red raspberry	Salmonberry	Snowberry	Thimbleberry	Black twinberry
Foliar applications																					
2,4-D ester	2.0-3.0 kg ae/ha	EF/LF	3	3		3			3		1	3					1	2	4	2	
	2.0-3.0 kg ae/ha	LS	3			2			3		1	3						2		2	
	2.0-3.0 kg ae/ha	D		1		1		2	2		0	2						1	2	1	
Glyphosate	1.5-2.1 kg ae/ha	EF/LF	4	3	3				3		3	3	3		2	2	3	3-4	4	3	4
	1.5-2.1 kg ae/ha	LS	2-3	3	4	0			1	3	1	3			3		3	4	3	3	3
Hexazinone	1.0-2.0 kg ai/ha	BB - EF		0		0			1			2									2
	2.0-4.0 kg ai/ha	BB - LF		2		0		1	2		1										
		BB - EF										3	3				2-3	2		3	3
	4.0-8.0 kg ai/ha	BB - EF						2	3			3			2		2	3		3	3
Triclopyr ester	1.0-2.0 kg ae/ha	EF - LS		2		3			3			3			2	2	3	3	3	2	3
	1.0-2.0 kg ae/ha	D		1		3			3			2			2	2	3	2	0	2	
	2.0-3.0 kg ae/ha	LF - LS		3		3			4			3			3		3	3		2	3
	3.0-4.0 kg ae/ha	EF				3			3			3						3		3	
	3.0-4.0 kg ae/ha	D				3			4									3			

HERBICIDE TREATMENT EFFECTIVENESS: SHRUBS, GRASSES, FERNS, AND FORBS IN B.C.*(CONT.)*

Injury: *0=no visible injury; 1=<25% (light); 2=25-60% (moderate); 3=60-90% (severe); 4=90-100% (very severe); blank=unknown*

Treatment Period (TP): *AS= All Season*

Herbicide	Rate	TP	Mountain alder	Sitka/green alder	False azalea	Scotch broom	Bitter cherry	Highbush cranberry	Stink currant	Devil's club	Red-osier dogwood	Elderberry	Dull Oregon grape	Hardhack	Black huckleberry	Red huckleberry	Red raspberry	Salmonberry	Snowberry	Thimbleberry	Black twinberry
Soil applications																					
Hexazinone	1.0-2.0 kg ai/ha	AS	0	0				0	0						2					0	
	2.0-4.0 kg ai/ha	AS	1	1	2			0	1		1	2		4	2		4	3	4	1	
	4.0-8.0 kg ai/ha	AS	1	2-3	3			1	2		3			4			4	4		2	
Cut-stump applications																					
2-4,D amine	30-100%	AS	2-3	3			4														
Glyphosate	25-50%	AS	2-3	2-3			4														
Triclopyr ester	20-30%	AS	2-3	3			4														
Stem injection																					
Glyphosate	1 Cap/5 cm dbh	AS	4	4																	
Bark Treatment																					
Triclopyr ester	2-3%	AS	3	3			4										3	2		2	
	20-30%	AS	4	4			4														

HERBICIDE TREATMENT EFFECTIVENESS: SHRUBS, GRASSES, FERNS, AND FORBS IN B.C. *(CONT.)*

Injury: *0=no visible injury; 1=<25% (light); 2=25-60% (moderate); 3=60-90% (severe); 4=90-100% (very severe); blank=unknown*

Treatment Period (TP): *BB=Bud break: new leaves; LF=Late Foliar, leaves fully expanded; EF: Early foliar: leaves 1/3 mature size; LS=Late summer, leaves fully mature + terminal growth completed; D=Dormant, winter before bud break or no decidious leaves; AS= All Season*

Herbicide	Rate	TP	Douglas maple	Vine maple	Wht. rhododendron	Roses	Salal	Saskatoon	Sitka mt. ash	Soopolallie	Willow	Bluejoint	Bracken	Cowparsnip	Deer fern	Lady fern	Sword fern	Stinging nettle	Fireweed	Forbs	Annual grasses	Perennial grasses
Foliar applications																						
2,4-D ester	2.0-3.0 kg ae/ha	EF or LF		2	1		1				2-3	0	1				0		2	4	0	0
	2.0-3.0 kg ae/ha	LS		2	1						2										0	0
	2.0-3.0 kg ae/ha	D		2			1				1	0	1				0				0	0
Glyphosate	1.5-2.1 kg ae/ha	EF or LF		3		4		3	3		1-2	3	4			4	3		2	3	4	4
	1.5-2.1 kg ae/ha	LS	3	3	3		1				2-3	2	3-4	2	2	2-3	2-3	3	3	3	4	4
	1.5-2.1 kg ae/ha	D																		1	4	3
Hexazinone	1.0-2.0 kg ai/ha	BB - EF			0	1	0	1			1	3							2	3-4		3
	2.0-4.0 kg ai/ha	BB - LF	1	1	0	3	0	2-3			2-3										4	1
	4.0-8.0 kg ai/ha	BB - LF	2			3-4					3-4											
Triclopyr ester	1.0-2.0 kg ae/ha	EF - LS		2	3		2															
	1.0-2.0 kg ae/ha	D		3	2	1-2	2															
	1.0-2.0 kg ae/ha	AS										0	1				2			3		
	2.0-3.0 kg ae/ha	LF - LS		2-3		2-3	3				1											
	3.0-4.0 kg ae/ha	EF		3			2				3											
	3.0-4.0 kg ae/ha	D		3			3															

HERBICIDE TREATMENT EFFECTIVENESS: SHRUBS, GRASSES, FERNS, AND FORBS IN B.C.*(CONT.)*

Injury: *0=no visible injury; 1=<25% (light); 2=25-60% (moderate); 3=60-90% (severe); 4=90-100% (very severe); blank=unknown*

Treatment Period (TP): *AS= All Season*

Herbicide	Rate	TP	Douglas maple	Vine maple	Wht. rhododendron	Roses	Salal	Saskatoon	Sitka mt. ash	Soopolallie	Willow	Bluejoint	Bracken	Cowparsnip	Deer fern	Lady fern	Sword fern	Stinging nettle	Fireweed	Forbs	Annual grasses	Perennial grasses
Soil applications																						
Hexazinone	1.0-2.0 kg ai/ha	AS	0			0	0		0		3	2							0	1		
	2.0-4.0 kg ai/ha	AS	1	1		2	2	4	2	3	3	3					2		3	3		3
	4.0-8.0 kg ai/ha	AS	2			3		4	3		3											
Cut-stump applications																						
2-4,D amine	30-100%	AS		3							3											
Glyphosate	25-50%	AS		3							4											
Triclopyr ester	20-30%	AS		4							4											
Stem injection																						
Glyphosate	1 Cap/5 cm dbh	AS									3											
Basal bark applications																						
Triclopyr ester	2-3%	AS		4							4											
	20-30%	AS		4							4											

Source for Pages A11 to A18: Biring, B.S., P.G. Comeau and J.O. Boateng (1996). Effectiveness of Forest Vegetation Control Methods in British Columbia. B.C. Min. For., Victoria, B.C. FRDA Handbook 011.

COMMENTS REGARDING TREATMENT EFFECTIVENESS OF SELECTED HERBICIDES

ASULUM (Asulox F)

- Avoid spraying if rain is expected within 8 hours, or if foliage is wet.
- Do not spray if hot, humid weather conditions.
- Do not spray if crop is under stress due to drought or excessive soil moisture.
- Do not cut vegetation or disturb site after treatment.
- Surfactant reduces effectiveness.

2,4-D

- Avoid spraying if rain is expected shortly
- Less effective control during prolonged hot, dry weather.
- Stump application of the herbicide must be done within 10 minutes after cutting.

GLYPHOSATE (Vision®)

- Rain after foliar application of glyphosate reduces effectiveness; - a 6 to 12 hour rain-free period is desired. Retreatment may be necessary if rain occurs within 2 hours after treatment.
- Extremely cool or cloudy weather at the time may slow down treatment activity.
- Uniform and complete spray coverage required for best efficacy.
- Excessive mechanical disturbance to a site just before and immediately after application may reduce effectiveness.
- Has no residual activity to control weeds that emerge after application.
- Requires a week or more to control annuals and longer for perennials.
- Low spray volumes are more effective than higher volumes.
- Stump treatment requires immediate treatment (within 5 minutes) with the herbicide after cutting.
- Control of perennial vegetation increases up to the flowering stage. Late summer to early fall application effective for woody plant control.
- Unclean water used for mixing, an unclean spray tank or vegetation heavily covered with dust can affect efficacy.
- Plant stress due to, for example, drought, disease and insect damage reduces effectiveness.
- Good results are obtained when applied on actively growing vegetation.

HEXAZINONE (Velpar L®, Pronone 10G®)

- Moisture is required to activate the herbicide. Soil should be moist at the time of application and 6 to 13 millimeters of rainfall is needed within 2 weeks after application.
- Do not use on gravelly soils or exposed subsoils or on coarse textured soils (sands to sandy loams) with less than 2% organic matter nor on fine soils (silts to clays) with less than 1% organic matter.
  The heavier the soil (increased concentration of organic matter, clay, silt) the higher the rate of Velpar, needed for control.
- Do not apply to frozen or snow covered soil.
- Foliar application of Velpar L® to competing vegetation is most effective under conditions of high temperature, high humidity and good soil moisture.
- Application when vegetation is dormant may not be effective.
- Do not use in nurseries, seedbeds or ornamental plantings because of injury to conifers.
- If used over top of conifers, do not use surfactant (Velpar L®).
- Do not use on trees which show poor vigour because of insects, disease, or winter injury or show symptoms of other stress conditions.

M.S.M.A. (Glowon®)

- Forked trees require individual treatment; M.S.M.A. does not translocate through root grafts.
- Overlapping frills are required to control large trees with full crown.

COMMENTS REGARDING TREATMENT EFFECTIVENESS OF SELECTED HERBICIDES *(CONTINUED)*

SIMAZINE
(Simazine 80W, Princep Nine-T®)

- Requires rainfall to be activated (chemical "washed into" root zone).
- Do not apply when ground is frozen or covered with snow.

TRICLOPYR ESTER (Release®)

- Rain has less impact after basal and stump treatment.
- Immediate treatment with triclopyr ester not required for stump treatment.
- Greatest efficacy occurs with basal treatment done in the fall when movement of the phloem contents is generally towards roots.
- Streamline spray technique provides optimum results with stems <8 cm basal diameter.
- Thinline, conventional and one-sided low volume techniques are suitable for stems < 15 cm diameter.
- For foliar broadcast application, a rate in the upper end of the recommended range should be used for sprouting or suckering species and tall or dense brush.

2,4-D ESTER + 2,4-DP ESTER
(Weedone CB®)

- Stump treatments do not require immediate application of the herbicide following cutting.

Notes:

SECTION B

INFORMATION ON HERBICIDE
PROJECT IMPLEMENTATION

HERBICIDE PROJECT CHECKLIST

STEPS:

1. Vegetation Management Prescription and Selection/Documentation of the Herbicide Option as the appropriate option for the site. ☐
2. Preparation of Draft Pest Management Plan (PMP) or Pesticide Use Permit (PUP) Applications as required ☐
3. Communications/Consultations/ Referrals/Inputs (through meetings, open houses, etc.)
   a) Contact: Applicable Resource Agencies ☐
   b) First Nations Use, Heritage Sites & Consultations ☐
   c) General Public, especially affected groups/individuals ☐
4. Preparation and Submission of final PMP/PUP application for Approval ☐
5. Meeting(s) or Discussion with concerned groups or individuals ☐
6. Approval of PMP, or PUP application ☐
7. Appeal Notification relating to approved PMP or PUP (if appealed) ☐
8. Appeal: Hearing or Written Submission ☐
9. Appeal Decision/Results ☐
10. Project Tendering ☐
11. Project Viewing and Contracting ☐
12. Equipment and Supplies Needed ☐
13. Personnel Needs and Training
    a) Supervisors ☐
    b) Crews ☐
14. Pre-operations Orientation
    a) Preparation for Pre-work Conference ☐
    b) Pre-work Conference with Contractor ☐
    c) Briefing of Ministry Personnel ☐
    d) Tentative Treatment (Flight) Plan (Project Layout Plan) Check: also for alternatives
    - spray schedule ☐
    - mixing schedule ☐
    - helispot/landing condition ☐
    - water sources ☐
    - road access ☐
    - emergency response plan ☐

    e) Notifications
    - Provide name and license number of Contractor to Local Deputy Administrator of the *Pesticide Control Act* and the Forest Regional Office ☐
    - Other notifications as required or stated in the PMP approval or PUP ☐

15. Pre-treatment: Equipment Checks
    a) Aircraft
    - aircraft type ☐
    - required spray system specification ☐
    - appropriate boom length ☐
    - proper nozzle: type, size, condition, e.g. placement, orientation, plugged or rusted nozzles ☐
    - inspection for leaks ☐
    - calibration: application rate, droplet size, spray pattern ☐
    - proper functioning of gauge ☐
    - air-ground radio compatibility ☐

    b) Batch Truck Check
    - chemical left over in tank from previous job ☐
    - leak in hoses, tanks and pump ☐
    - tank: size, compartmentation and material ☐
    - screens and line filter ☐
    - functioning agitation system ☐
    - mechanism to prevent back siphoning ☐
    - secure and safe locking device ☐
    - vehicle safety regarding fire regulations ☐

    c) Backpack Sprayers
    - inspection for tank, hose or nozzle leaks ☐
    - appropriate nozzle ☐
    - sprayer flushing before use ☐

    d) Truck-Mounted Sprayer
    - presence of agitator, if necessary ☐
    - inspection for leaks ☐
    - tank flushing before use ☐

    e) Injection/Hack and Squirt Equipment
    - applicator or container leaks ☐
    - capability of delivering required chemical ☐

HERBICIDE PROJECT CHECKLIST *(CONTINUED)*

16. Day before Treatment Checks
- a) Equipment Needs ☐
- b) Weather Forecast ☐
- c) Review of Treatment Area with Applicator (Contractor) ☐
- d) Discussion of Spray Operation with Key Personnel ☐
- e) Designation of mixing and disposal sites
- f) Spray Mixture Calculation Checks ☐
- g) Chemical Security Plan ☐

17. Daily Spray Operations
- a) Daily general briefing ☐
- b) Prior to Treatment Checks
  - • required equipment and materials including minimum protective clothing and equipment ☐
  - • First Aid and Spill Kit on site ☐
  - • contingency plan ☐
  - • posting of information signs, e.g. Road Closure Sign ☐
  - • monitoring: equipment and treatment plan (placement of spray monitoring cards and/or other samplers) ☐
  - • boundary and swath markers ☐
  - • contractor's (or pilot's) knowledge of treatment area, "pesticide free zones", buffer areas, water bodies and hazards (e.g. snags) ☐
  - • mixing and loading: applicator's (mixer's) awareness of required rates and carrier volume ☐
  - • radio communications: (especially ground-to-air) ☐
  - • equipment calibration/ monitoring ☐
  - • weather monitoring ☐
- c) During the Operation Monitoring: Check
  - • secure and safe work conditions and procedures ☐
  - • deposit cards and/or other samplers ☐
  - • weather condition: wind speed and direction, temperature and humidity ☐
  - • application height and speed ☐
  - • spray pattern and swath width ☐
  - • spray drift and movement to non-target areas ☐
  - • performance of application equipment: leaks, plugged nozzles ☐
  - • application rate ☐
  - • collection and viewing of spray monitoring cards and/or other supplies ☐
  - • recording of operational activity ☐
- d) End of Daily Operation Check
  - • rinsing and empty container removal ☐
  - • mixing and loading site clean-up ☐
  - • posting of sprayed areas: information signs ☐
  - • aircraft and batch tank security check ☐
  - • closure of valves or valve compartment of batch truck ☐
  - • notification of pesticide use infringements to Local Deputy Administrator of the *Pesticide Control Act* and Ministry of Forests district and regional offices ☐
- e) Daily de-briefing ☐
- f) Communication Plan: Check-in Procedures ☐

18. Project Completion (Post-operations) Checks
- a) Final Clean-up: Mixing / Loading Site(s) and Camp Site ☐
- b) Disposal of Excess Mixture ☐
- c) Clean-up of Pumps, Hoses, Vehicles, Aircraft and Spray Equipment ☐
- d) Disposal of Waste and Empty Containers ☐
- e) Delivery of "Returnable" Containers to Pick-up Depot ☐
- f) Removal of Appropriate Signs and Markers ☐
- g) Paperwork completion ☐
- h) Inventory of Chemicals: amount used and amount remaining ☐
- i) Replacement of Supplies ☐
- j) Equipment Repair, Maintenance and Replacement ☐
- k) Project Completion Debriefing ☐

19. Submission of End of Year Pesticide Use Report ☐

20. Project Evaluation ☐

APPLICATION EQUIPMENT AND SUPPLIES: CHECKLIST

- **1.** Herbicides, Adjuvants, Dyes Carrier ☐
- **2.** Project Monitoring Equipment and Material
  - a) Dye kit (plastic gloves, funnel, mixing containers) ☐
  - b) Spray deposit cards and/or other monitoring supplies ☐
  - c) Measuring Tape (Broadcast Spraying) ☐
  - d) Camera and Film ☐
  - e) Field Notebooks and Pencils ☐
- **3.** Radios (and radio batteries) ☐
- **4.** First Aid Kits ☐
- **5.** Spill Kits including Contingency Plan ☐
- **6.** Emergency Contact List ☐
- **7.** Protective Gear: e.g. Coveralls, Gloves, Goggles, Boots, etc. ☐
- **8.** Wash kit (water containers, basin, soap)
- **9.** Water Sampling Equipment and Material (where applicable) ☐
- **10.** Weather Instruments:
  - a) Psychrometer (Humidity gauge) ☐
  - b) Humidity Chart (where applicable) ☐
  - c) Wind Gauges ☐
  - d) Thermometer ☐
- **11.** Calibration Equipment and Supplies: e.g.,
  - a) Deposit cards ☐
  - b) Adding machine tape ☐
  - c) Stop watch ☐
  - d) Calculator ☐
  - e) 50-m measuring tape ☐
- **12.** Documents:
  - a) Pest Management Plan(s) or Pesticide Use Permit Application(s) and Pesticide Use Permit ☐
  - b) Licences and Certificates: Contractors and Workers ☐
  - c) Contract ☐
  - d) Results (Data) of Provincial Equipment Check, Calibration and Performance Tests (where applicable) ☐
- **13.** Photos and Maps ☐
- **14.** Information on the Pesticide(s) planned to be used
  - a) Labels ☐
  - b) Material Safety Data Sheet(s) ☐
- **15.** Forms
  - a) Herbicide Operation Records ☐
  - b) Daily Flight or Treatment Log (kept by Service Licensee) ☐
  - c) Application Table(s) or Pesticide Field Data Book ☐
- **16.** Public Notification Signs ☐

EXAMPLES OF DYES FOR MONITORING HERBICIDE APPLICATION

Dye	Mixing Ratio
Basazol Blue	1 part of Basazol Blue in 1000 parts spray solution Increase or decrease amount to suit purpose
Basazol Red	1 part of Basazol Red in 1000 parts spray solution Increase or decrease amount to suit purpose
Bulls Eye	Aerial and Ground Broadcast: 125-400 ml Bulls Eye per 20-100 litres spray solution Handspray gun or Boom: 125-250 ml Bulls Eye per 100 litres of application solution Spot gun: 40 ml Bulls Eye per 5 litres of solution

HERBICIDE PROJECT PRE-WORK CONFERENCE: CHECKLIST

1. Contract/Project No. ☐
2. Approved pesticide use document: Pesticide Management Plan/Pesticide Use Permit ☐
3. Location, Date, Time of Pre-work Conference ☐
4. Contract Officer's Name and Phone Number ☐
5. Contractor's Basic Information:
   a) Name, Address and Phone No. ☐
   b) Pesticide Service Licence No. ☐
   c) Applicators' Certificates and Licenses ☐
   d) Applicable Insurance and Expiry Date(s) of Policies ☐
   e) Workers' Compensation Board Number ☐
6. Basic Training Requirements for Contractors and Workers ☐
7. Supervision: Contractor's Workers
   a) Supervisor/worker ratio ☐
   b) Project Supervisor's name ☐
8. Contractor's Proof of satisfying Provincial Equipment Check, Calibration, and Performance test requirements: currently required for all aerial spray equipment systems. ☐
9. Pilot (Aerial Application)
   a) Name and experience ☐
   b) Experience and Qualifications as per Ministry of Forests' Aviation Management Requirements (Reference: Aviation Safety Manual [Protection Branch]).
   - Hours flown as a commercial Pilot-in-Command (P.I.C.). ☐
   - Hours flown as P.I.C. on specific aircraft type or combination of similar types to be used for project. ☐
   - Record(s) of forest area (ha) aerially sprayed with pesticides. ☐
   - Appropriate licences and operating certificates and approvals ☐

   c) Pilot's weight for maximum load calculation ☐
   d) Check if pilot is the same used for contract viewing ☐
10. General Review of Contract Schedules and Clauses ☐
11. Review of applicable section of Pest Management Plan or Pesticide Use Permit Conditions ☐
12. Safety Requirements
    a) Worker's Safety Equipment and Clothing ☐
    b) First Aid Kit ☐
    c) Spill Kit ☐
    d) Wash-up Facilities ☐
    e) Camp Standards ☐
13. Communication System ☐
14. Emergency Response Plan ☐
15. Herbicide Handling and Storage
    a) Pick-up Location and Delivery to Site ☐
    b) On-site Storage ☐
16. Fire Prevention Regulations and Fire Protection Information ☐
17. Locations and conditions for:
    a) Helispots/airstrips ☐
    b) Access Roads ☐
18. Herbicide Mixing
    a) Location ☐
    b) Water Source ☐
    c) Mixing Procedure ☐
19. Herbicide Project Layout and Herbicide Application
    a) Project Layout: Schedule of Blocks for Treatment ☐
    b) Pesticide Free Zones ☐
    c) Buffer/Boundary Markings ☐
    d) Review of Problem Areas ☐
    e) Application Equipment ☐
    f) Application Method/Technique ☐
    g) Need for additional Equipment Calibration ☐
    h) Weather Conditions for Application and project shut-down. ☐
20. Record Keeping: Herbicide Operations ☐

HERBICIDE PROJECT PRE-WORK CONFERENCE: CHECKLIST *(CONT.)*

21. Site Clean-up and Empty Container Handling
- a) Site/Camp Clean-up ☐
- b) Disposal of Left-over Spray Mixture ☐
- c) Disposal of Empty Containers ☐
- d) Delivery of "Returnable" Empty Containers ☐

22. Project Administration, Monitoring and Inspection
- a) Project Commencement Date ☐
- b) Project Completion Date ☐
- c) Order of Work ☐
- d) Expected Production Rate ☐
- e) Notice to Commence Work ☐
- f) Required Supervision ☐
- g) Signed Work Progress Plan ☐
- h) Monitoring and Inspection Methods ☐
- i) Required Work Standards ☐
- j) Stop Work Order Conditions and Contract Cancellation ☐
- k) Rework Order ☐

24. Payment Method (including Policy and Hold-back Required) ☐

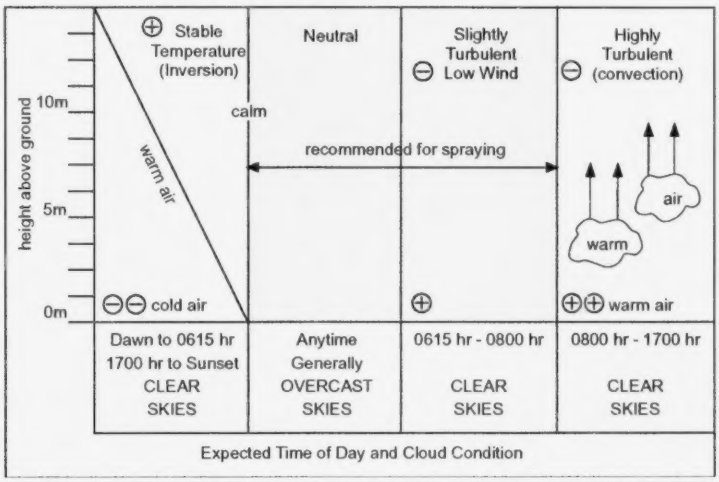
Notes:

WEATHER CONDITIONS LIMITING HERBICIDE BROADCAST SPRAYING

WEATHER	ADVERSE CONDITIONS*	
	GROUND SPRAYING	AERIAL SPRAYING
Wind	• Wind velocity exceeding 8 kph • Wind blowing towards adjacent non-target or "sensitive" areas	• Wind velocity exceeding 8 kph or when wind is dead calm • Wind blowing towards adjacent non-target or "sensitive" areas
Temperature	• Freezing temperature or temperature greater than 30° C • When RH and temperature conditions create uncomfortable conditons for ground workers	• When temperature exceeds 21° C for application with ester formulated products (e.g. Esteron 600®) • When temperature exceeds 26.5° C for application with amine form- (e.g. 2,4-D Amine or Vision®) • When temperature is at or below 0° C
Relative Humidity (RH)	• RH less than 30% • When RH and temperature conditions create uncomfortable conditions for ground workers	• RH less than 50% • RH as low as 40% may be accepted when high volume and large droplets (as produced by D8-46 or D10-46) and drift control nozzles such as Thru-valve® and Accuflo® are used
Precipitation	• Snow, heavy dew or ice covers vegetation • When raining • When precipitation is predicted within 6 hours following foliar herbicide application with herbicides such as Vision® or 2, 4-D. Check label for specific instructions for herbicide planned for use	• Snow or ice covers vegetation • When vegetation is too wet (as a result of heavy dew or precipitation) • When raining • When precipitation is predicted within 6 hours following foliar application of herbicides such as Vision® and 2,4-D. Check label for specific instructions for herbicides planned for use.
Atmospheric Instability and other conditions	• Foggy weather and inadequate daylight for safe application	• Inversion or other still air conditions • Air turbulence (e.g. thermal updrafts) so great as to seriously affect the normal application pattern • Foggy weather and inadequate daylight for safe application

*When spraying should not occur

RECOMMENDED TIME AND CONDITIONS FOR AERIAL SPRAYING



Notes:

- ⊕ Warmer Air
- ⊖ Cold Air
- Sunrise is assumed to be 0600 and sunset at 1900. Adjust schedule to local time.
- If spraying is done under stable conditions, small spray droplets tend to remain suspended in air. When wind comes up, the spray droplets can be blown off target.
- Under highly turbulent conditions wind direction tends to change in unpredictable manner. Chances are that droplets can blow off target area.

References:

Handbook on Aerial Application of Herbicides. USDA Forest Service (1983) R-5 FSH 2109.01

Correct Aerial Application of Herbicide. CIBA GEIGY Agricultural Chemical Division, Basel, Switzerland.

Notes:

REDUCING OFF-TARGET DEPOSITION AND SPRAY DRIFT POTENTIAL

1. Use properly serviced and well calibrated spray equipment

2. Use the appropriate application method/technique and experienced applicators with sound judgement.

3. For aerial herbicide spraying:
   - use larger and more uniform droplets. Droplets with 250-500 micron diameters are suitable for most forest spraying
   - use booms equipped with coarse droplet producing conventional disc and core nozzles (e.g. D8-46 or D10-46), straight stream coreless nozzles (e.g., D8), or the newer drift control specialty nozzles (e.g., Accuflo®, Thru Valve® Boom (TVB), Microfoil® Boom). Larger and uniform droplets are produced by these specialty nozzles.
   - the spray pressure used must be no greater than required to provide uniform coverage. Pressure must be below 235 kPa
   - the effective boom length must be no greater than 75% of the wing span
   - nozzles must not be placed where spray will enter wing-tip vortices.
   - place nozzles directed straight out or at an angle of less than 30 degrees down
   - spray at proper application speed as recommended for the spray system.

4. For ground herbicide spraying:
   - spray at low pressures, not exceeding 275 kPa for power operated sprayers.
   - Direct spray no higher than the tops of the target vegetation.
   - For backpack applications do not spray vegetation taller than 2 metres

5. Spray under ideal weather conditions. See page on "Weather Conditions limiting Herbicide Broadcast Spraying".

6. Spray only when wind is blowing away from sensitive or non-target areas

7. Spray as close to the target (e.g. vegetation) as possible while maintaining good coverage. Greater spraying height can lead to increased drift, especially with aerial herbicide application.

8. Use the appropriate buffers to protect "Sensitive" areas and Pesticide Free Zone(s) along or around sensitive areas such as streams, rivers and lakes. The specialty nozzles (e.g. Accuflo® and TVB® nozzles are particularly good for aerial spraying along sensitive areas.

9. Use drift control additives where recommended by the label. Follow label instructions.

Notes:

SECTION C

EQUIPMENT CALIBRATION AND
RELATED INFORMATION

BACKPACK AND POWER OPERATED GROUND SPRAYER CALIBRATION

FACTORS AFFECTING CALIBRATION

Vegetation height/density

Low vegetation and/or scattered clumps will require less solution per hectare than taller and dense vegetation with greater leaf surface.

Nozzle and pressure

Solution delivery from the sprayer varies with the nozzles used and/or pressure. For most herbicide projects the suggested pressure is 100 to 140 kPa (15 - 20 psi) for backpack sprayers and 175 to 240 kPa (25 - 35 psi) for power operated sprayers.

Ground Conditions

For backpack projects the ground conditions (slash, slope, etc.) will affect the workers walking speed, which directly affects the delivery rate per hectare. If conditions vary substantially within the site or from site to site, the equipment should be recalibrated.

The most accurate method of calibration is to actually spray an area of known size and measure the amount of solution used over this known area.

CALIBRATION STEPS:

1. Install the appropriate spray tip (e.g. Teejet 8003)
2. Partially fill the sprayer with clean water and dye.
3. Pump up the spray unit to a selected preasure
4. Ensure there is no leakage from equipment.
5. Test spray sample cards to check spray droplet pattern. If necessary adjust or change nozzles and pressure to achieve desired spray droplet pattern.
6. Measure the effective swath width (e.g. 3 m).
7. Fill the spray tank with a known quantity of water.
8. Spray a small homogeneous area of known length and width (e.g. 0.25 ha or 10m X 250 m) at the desired pressure and speed (to be used in the field).
9. Measure the volume of water remaining in the spray tank.
10. Calculate the litres used and determine spray output in litres per hectare (litres used divided by hectares of test area).

Generally, the equipment is adjusted to deliver the solution within a certain range (e.g. 75 - 125 L/ha). To achieve the desired rate the worker can change the nozzle(s) or speed of the equipment. **It is not advisable to increase the pressure to increase the delivery rate, as this will result in fine droplets susceptible to drift.**

With backpack sprayers, it can be difficult to maintain a consistent pressure and walking speed, which is necessary for uniform application. A pressure regulator valve, which is available as an option if not already built into the sprayer, will ensure uniform delivery of solution from the sprayer. Close attention must be paid to walking speed in order to minimize variation in application rates.

AERIAL SPRAYER SYSTEM CALIBRATION CHECKLIST

EQUIPMENT AND SUPPLIES

- Stopwatch ☐
- Calculator ☐
- Paper and Pencils ☐
- Calibration Tables (e.g. Manufacturer's Calibration Tables) ☐
- Calibrated bucket ☐
- Adding machine tapes ☐
- Deposit Cards (e.g. Kromekote cards) or Deposit Samplers ☐
- Dye (where applicable) ☐
- Gauge for measuring nozzle orifice diameter (optional) ☐
- Gauge for measuring angle(s) of the mounted boom and nozzles ☐
- 50-metre measuring tape ☐

CALIBRATION PROCECURES

1. Ensure that the required boom, nozzle type and number are selected and mounted according to specifications. ☐
2. Check to ensure that safety equipment is mounted on the aircraft. ☐
3. Check from the manufacturers' literature the recommended pump pressure, application speed and swath width for the spray system. ☐
4. Check Functioning of the Sprayer System
   - Wash out tank to remove dirt or oil ☐
   - Check hoses for holes and wear ☐
   - Check pump to be sure it turns freely ☐
   - Check strainer screen ☐
   - Clean, replace or repair defective part ☐
   - Check functioning of meter(s) ☐
5. Sprayer Delivery System Priming (i.e. filling the plumbing [lines] with liquid)
   - Add about 75 litres of water into spraying tank (hopper) ☐
   - Spray system until empty (as boom pressure starts to drop, shut off boom) ☐
   - Check for leaks or clogged nozzles ☐
   - Repair leaks and nozzle problems or replace nozzle (5) ☐
6. Measuring Discharge Time
   - Add measured amount of water (between 125 and 250 L) into tank using automatic delivery system or with calibrated bucket. ☐
   - Measure the time required to empty tank at the chosen operating pressure and speed. ☐
   - Compare measured time with the values calculated for the chosen swath width, speed, application rate (volume/area), using ☐
7. Measured Discharge time good, refer to item 10. ☐
8. Measured Discharge time incorrect, refer to item 9. ☐
9. Discharge Time Adjustment

   a) If measured time less than tabulated minimum value; repeat calibration procedure after one of these:
   - Checking and replacing worn (oversize) nozzles ☐
   - Removing or shutting off some of the nozzles (Always start from the boom end.) ☐
   - Adjusting for proper boom pressure, if too high* ☐

   b) If measured time greater than tabulated maximum value; repeat calibration procedure after one of these:
   - Cleaning or replacing nozzles ☐
   - Increasing the number of nozzles ☐

AERIAL SPRAYER SYSTEM CALIBRATION CHECKLIST *(CONT.)*

- Adjusting for proper boom pressure, if too low (see note below) ☐

c) Erratic Discharge Time (after 3 trials). Check for:
- Defective Pump System ☐
- Presence of foreign material (dirt) in spray system, batch truck, calibration solution ☐
- Defective Batch Truck Meter ☐
- Defective or incorrectly used stop watch ☐

10. Spray System Calibration Check in the air
- Spray a swath. Check effective swath width, extent of the droplet distribution across the flight line, average droplet size, droplet spectrum, and droplet distribution (number per unit area)**. Adjust if necessary. ☐
- Measure a unit area accurately ☐
- Spray the whole unit (using the chosen pressure and speed) and record the spray volume used ☐
- Check for correct application rate (volume/area)*** ☐

Notes:

* Major change of pressure not recommended. In general the pressure should be left alone; only minor changes in delivery rate can be achieved by changing the pressure.

** At least 13 droplets/cm^2 are needed for phenoxy herbicides (Newton & Knight, 1981. Handbook of Weed and Insect Control Chemicals for Forest Resource Managers. Timber Press. Oregon.) For most herbicides, no more than 20 and 40 droplets/cm^2 are required for pre-emergence and post-emergence, respectively (Ciba-Geigy, Correct Aerial Application of Pesticides).

***Operational acceptability: Error within ±5% is preferred but up to 10% error is operationally acceptable.

Comments:

SELECTING THE NUMBER OF NOZZLES FOR BROADCAST APPLICATION

A. SELECTING THE RIGHT NOZZLE SIZE

1. Determine the area the system treats per minute. Choose a swath-width and speed. Calculate or read from graph or tabulated values from manufacturers' tables.

2. Determine the total litres per minute (flow rate) required to apply the recommended application rate.

3. Determine Flow Rate per Nozzle
   Calculation: Divide total flow rate (2 above) by the number of nozzles.

4. Nozzle Selection
   - Refer to the appropriate Nozzle Capacity Table
   - Choose an operating pressure
   - Find the flow rate (Capacity for one nozzle) that comes closest to matching the calculated flow rate
   - Select the nozzle delivering the flow rate (L/min/nozzle) at the chosen operating pressure.
   - Test or refer to appropriate tables to verify if the selected nozzle will give you the droplet size for the intended job.

B. ESTIMATION OF THE NUMBER OF NOZZLES NEEDED

1. Decide on type of nozzle, swath width, speed, operating pressure.

2. Determine hectares treated per minute.

3. Determine total litres per minute needed to apply the recommended rate

4. From manufacturers' tables find the litres delivered per minute per nozzle for the chosen nozzle and pressure.

5. No. of nozzles needed = $\frac{\text{Total litres delivered /minute}}{\text{Litres delivered/minute/nozzle}}$

Notes:

SOME CALCULATIONS RELATING TO AERIAL SPRAY SYSTEM CALIBRATION

A. Calculation of litres the system sprays per minute (L/min) when the following are known:

Speed of the sprayer (e.g. aircraft) = 70 km/h
Swath width = 15 m
Application rate = 50 L/ha

Solution:

$$\text{Flow rate}^{a} = \frac{\text{Speed (km/h) X Swath Width (m) X Application Rate (L/ha)}}{\text{600 (Conversion Factor)}^{b}}$$

$$= \frac{70 \text{ X } 15 \text{ X } 50}{600}$$

$$= 87.5 \text{ L/min}$$

Notes:
[a] To calculate the flow rate per nozzle (L/min/nozzle), divide total rate by number of spraying (open) nozzles.
[b] Conversion factor for miles per hour (mph) = 373

B. Calculation of litres the system sprays per hectare (L/ha) when the following are known:

Speed of the sprayer (e.g. aircraft) = 70 km/h
Swath width = 15 m
Flow rate of the system = 87.5 L/min

Solution:

$$\text{Amount sprayed/area (L/ha)} = \frac{\text{Amount Sprayed per min (L/min) X 600}}{\text{Swath Width (m) X Speed (km/h)}}$$

$$= \frac{87.5 \text{ X } 600}{15 \text{ X } 70}$$

$$= 50 \text{ L/ha}$$

C. Calculation of hectares treated per minute when the following are known:

Speed of the sprayer (e.g. aircraft) = 70 km/h
Swath width = 15 m

Solution:

$$\text{Hectares/min} = \frac{\text{Swath width (m) X Speed (Km/h)}}{600}$$

$$= \frac{15 \text{ X } 70}{600}$$

$$= 1.75 \text{ ha / min}$$

Notes: To calculate flow rate/min from hectares/minute, multiply hectares/minute by the application rate.

SOME CALCULATIONS RELATING TO AERIAL SPRAY SYSTEM CALIBRATION *(CONTINUED)*

D. Calculation of Number of Nozzles needed for spraying when the following are known:

Swath width = 18 m
Speed of the sprayer (e.g. aircraft) = 72 km/h
Operating pressure = 160 kPa
Nozzle type and size = D8 - 46

Solution:

$$\text{Hectares/minute} = \frac{\text{Swath width x speed}}{600}$$

$$= \frac{18 \times 72}{600} = 2.16 \text{ ha/min}$$

Litres/minute = hectares/min x application rate
= 2.16 X 50 L/ha = 120.96 L/min

From the manufacturer's data, the delivery rate of D8 - 46 nozzle at 160 kPa is 5.43 min / nozzle

$$\text{Therefore the number of nozzles} = \frac{120.96}{5.43}$$

$$= 22.27$$

$$= 22$$

Notes:

SPRAY AREA COMPUTATION TABLE OF AIRCRAFT SPEED AND SWATH WIDTH

Swath Width (m)																	
Speed		5	9	10.5	12	13.5	15	16.5	18	19.5	21	22.5	24	25.5	27	28.5	30 m
kph	mph	8	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100 ft
Hectares Sprayed per Minute = Swath width X kilometres per hour / 600																	
40	25	0.33	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
64	40	0.53	1.0	1.1	1.3	1.4	1.6	1.8	1.9	2.1	2.2	2.4	2.6	2.7	2.9	3.0	3.2
72	45	0.60	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.5	2.7	2.9	3.1	3.2	3.4	3.6
80	50	0.67	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
88	55	0.73	1.3	1.6	1.8	2.0	2.2	2.4	2.6	2.9	3.1	3.3	3.5	3.8	4.0	4.2	4.4
96	60	0.80	1.4	1.7	1.9	2.2	2.4	2.6	2.9	3.1	3.4	3.6	3.8	4.1	4.3	4.6	4.8
104	65	0.87	1.6	1.8	2.1	2.4	2.6	2.9	3.1	3.4	3.6	3.9	4.2	4.4	4.7	5.0	5.2
112	70	0.93	1.7	2.0	2.2	2.5	2.8	3.1	3.4	3.6	3.9	4.2	4.5	4.8	5.0	5.3	5.6
120	75	1.00	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.4	5.7	6.0
128	80	1.07	1.9	2.2	2.6	2.9	3.2	3.5	3.8	4.2	4.5	4.8	5.1	5.4	5.8	6.1	6.4
136	85	1.13	2.0	2.4	2.7	3.1	3.4	3.8	4.1	4.4	4.8	5.1	5.4	5.8	6.1	6.5	6.8
144	90	1.20	2.2	2.5	2.9	3.2	3.6	4.0	4.3	4.7	5.0	5.4	5.8	6.1	6.5	6.8	7.2
152	95	1.27	2.3	2.7	3.0	3.4	3.8	4.2	4.6	5.0	5.3	5.7	6.1	6.5	6.8	7.2	7.6
160	100	1.33	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.0
168	105	1.4	2.5	3.0	3.4	3.8	4.2	4.6	5.0	5.5	5.9	6.3	6.7	7.2	7.6	8.0	8.4
176	110	1.47	2.6	3.1	3.5	4.0	4.4	4.8	5.3	5.7	6.2	6.6	7.0	7.5	7.9	8.4	8.8
184	115	1.53	2.8	3.2	3.7	4.2	4.6	5.1	5.5	6.0	6.4	6.9	7.4	7.8	8.3	8.8	9.2
192	120	1.60	2.9	3.4	3.8	4.3	4.8	5.3	5.8	6.2	6.7	7.2	7.7	8.2	8.6	9.1	9.6
200	125	1.67	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0

- This table shows the spray application rate in hectares per minute when the swath width and aircraft spraying speed are known. (Hectares sprayed per minute = Swath width × kph/600)
- To find the rate of flow in volume per minute (or weight per minute) multiply the hectares per minute figure by the volume or weight per hectare to be applied.
- To convert the hectares sprayed per minute into acres sprayed per minute, divide the figure by 0.4.
- Acres sprayed per minute can also be calculated by the formula: 2 X swath width in feet X miles per hour / 1,000
- 1 acre = 0.4 hectare; 1 mph = 1.6 kph; 1ft = 0.3 m.

SPRAY AREA COMPUTATION TABLE OF SWATH LENGTH AND WIDTH

Swath Length (m)	Swath Length (ft)	Swath Width (m): 9	10.5	12	13.5	15	16.5	18	19.5	21	22.5	24	25.5	27	28.5	30 m
		30	35	40	45	50	55	60	65	70	75	80	85	90	95	100 ft
Hectares Sprayed = Swath Width (m) x Swath Length (m)/1000																
100	330	0.09	0.11	0.12	0.14	0.15	0.17	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.29	0.30
200	660	0.18	0.21	0.24	0.27	0.30	0.33	0.36	0.39	0.42	0.46	0.48	0.52	0.54	0.58	0.61
300	990	0.27	0.32	0.36	0.41	0.45	0.50	0.54	0.59	0.64	0.68	0.73	0.77	0.82	0.86	0.91
400	1320	0.36	0.42	0.48	0.54	0.61	0.67	0.73	0.79	0.85	0.91	0.97	1.01	1.09	1.15	1.21
500	1650	0.46	0.53	0.61	0.68	0.76	0.83	0.91	0.98	1.06	1.14	1.21	1.29	1.36	1.44	1.52
600	1980	0.54	0.64	0.72	0.82	0.91	1.00	1.09	1.18	1.27	1.36	1.40	1.54	1.64	1.73	1.82
700	2310	0.64	0.74	0.85	0.97	1.09	1.21	1.33	1.46	1.48	1.59	1.70	1.80	1.91	2.02	2.12
800	2640	0.73	0.85	0.97	1.09	1.21	1.33	1.46	1.58	1.70	1.82	1.94	2.10	2.18	2.30	2.42
900	2970	0.82	0.96	1.09	1.23	1.36	1.50	1.64	1.77	1.91	2.04	2.18	2.32	2.46	2.59	2.73
1000	3300	0.91	1.06	1.21	1.36	1.52	1.67	1.82	1.97	2.12	2.27	2.42	2.58	2.73	2.88	3.03
1100	3630	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.17	2.33	2.50	2.67	2.83	3.00	3.17	3.33
1500	4950	1.36	1.59	1.82	2.04	2.27	2.50	2.73	2.96	3.18	3.41	3.64	3.86	4.09	4.32	4.54
2000	6600	1.82	2.12	2.42	2.73	3.03	3.33	3.64	3.94	4.24	4.54	4.85	5.15	5.46	5.78	6.06
2500	8250	2.27	2.65	3.03	3.41	3.79	4.17	4.54	4.92	5.30	5.68	6.06	6.44	6.82	7.20	7.58
3000	9900	2.73	3.18	3.64	4.09	4.54	5.00	5.46	5.91	6.36	6.82	7.27	7.73	8.18	8.64	9.09

- This table shows the number of hectares covered in a swath of a given width and length. For swath widths other than those shown, interpolate or use combinations of the figures shown or calculate with the formula:

$$\text{Hectares covered} = \frac{\text{Swath width (m)} \times \text{Swath length (m)}}{10000}$$

- To determine the amount of chemical required, multiply the hectares by the rate of application.
- 1 acre = 0.4 hectare; 1ft = 0.3 m (approx.)
- To convert the hectares covered into acres covered, multiply the hectares by 2.5. Acres covered can also be calculated by the formula:

$$\frac{\text{Swath Length (ft) X Swath Width (ft)}}{43560}$$

SUGGESTED SPRAY NOZZLES AND TIPS

Spray Application	Nozzle Tip	Examples
Aerial Broadcast		
	Conventional Types; Hollow Cone (Disc - Core)	Delavan Raindrop Regular Disc-core D8-46 D10-46
	"New" or "Specialty" types	• Accuflo®(0.016-64) (0.028-32) • CP 0.125 • Microfoil® 0.13" orifice, triple row nozzle • TVB® 45 Boom with 0.045" burr nozzle • Spray Disc
Ground Broadcast		
	Flat Fan	Teejet® 650067
	Flooding Flat Fan	D.75 SS
	Straight (Solid) Stream	1505-45
	Cluster or Boomless (Broadcast)	Boomjet 5880
Band/Strip		
	Even Flat Fan	Teejet® 9503E
Bark Treatment		
Thinline Spraying	Straight (Solid) stream	TP 0001
One-sided low volume	Even Flat Fan	Teejet® 8003E
Conventional volume	solid (full) Cone	TG-1
Streamline		
Dormant		
Spot		
Grid pattern	Straight (Solid) stream	TP 0001, TP 0002
or individual stem		TP 0003
Tree-centred spots		
	Hollow cone	DC 3-25
(herbaceous vegetation)	Solid Cone	TG -1
Cut Stump		
	Flat Fan	Teejet 8003E
	Solid (full) Cone	TG -1

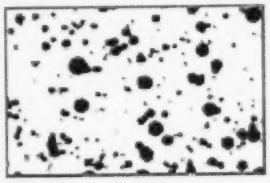
Sources:

Cantrell, R.L. 1985. Guide to Silviculture Use in the Southern United States. Auburn University, Alabama.

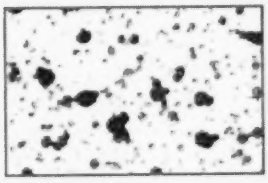
Newton, M. and F.B. Knight 1981. Handbook of Weed and Insect Control Chemicals for Forest Resource Managers, Timber Press. Beaverton, Oregon.

Nozzle Manufacturers Catalogues and Brochures.

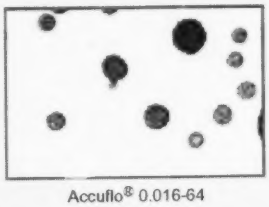
TYPICAL SPRAY PATTERNS* OF SOME NOZZLES USED FOR AERIAL HERBICIDE APPLICATION IN B.C.



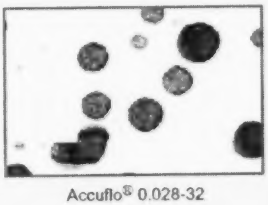
D8-46



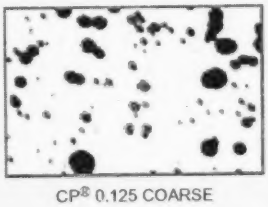
D10-46



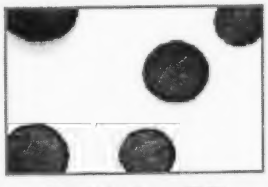
Accuflo® 0.016-64



Accuflo® 0.028-32



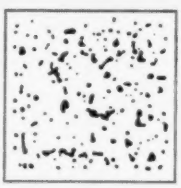
CP® 0.125 COARSE



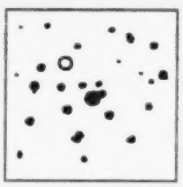
Thru-Valve Boom (TVB)

* **Note:** Taken around Swath Centre

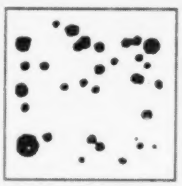
HERBICIDE SPRAY PATTERNS EVALUATION BASED ON EFFICACY



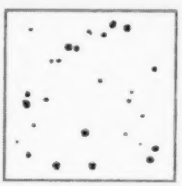
A. SIZE GOOD
DENSITY EXCELLENT



B. SIZE EXCELLENT
DENSITY GOOD



C. SIZE GOOD
DENSITY GOOD



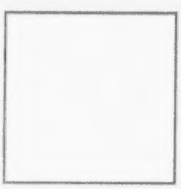
D. SIZE GOOD
DENSITY FAIR

CUT OUT HERE

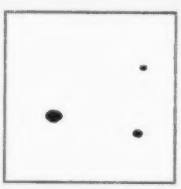
ONE SQUARE INCH

PROCEDURE:

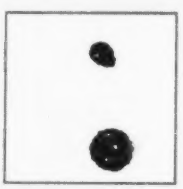
- place spray deposit card beneath this page.
- compare spray deposits with examples from this page.
- record evaluation



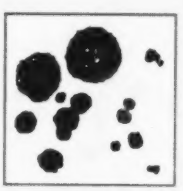
E. IDEAL PATTERN FOR
NON-TARGET AREAS



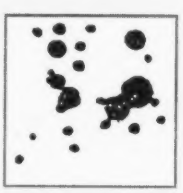
F. SIZE GOOD
DENSITY POOR



G. SIZE FAIR
DENSITY POOR



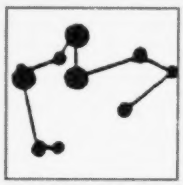
H SIZE POOR
DENSITY GOOD



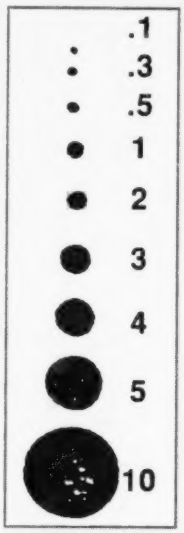
I. SIZE FAIR
DENSITY FAIR

J. SIZE POOR
DENSITY POOR

HERBICIDE SPRAY PATTERNS EVALUATION BASED ON EFFICACY *(CONTINUED)*



METHOD FOR COUNTING DOTS



DROPLET SIZE (millimetres)

Ideal Patterns based on Treatment Efficacy

- 70 or more droplets per sq. in.
- most droplets 0.7 to 2.2 mm
- no droplets > 7 mm
- few droplets < 3 mm
- outside buffer zone, no droplets on non-target area cards

Source: Modified from: Handbook on Aerial Application of Herbicides. USDA Forest Service (1983) R-5 FSH 2109.21

Notes:

SECTION D

PROJECT MONITORING AND
EFFECTIVENESS EVALUATION

HERBICIDE PROJECT: OPERATION RECORD KEEPING

1. ADMINISTRATION AND AREA IDENTIFICATION

Region:	Opening No./Map Reference:
District:	Licensee:
Location:	Biogeoclimatic Zone/Subzone:
Vegetation Complex:	Pesticide Use Permit/Pest Management Plan Approval No.:

2. TREATMENT OBJECTIVE AND SITE CONDITIONS

Objective (e.g. Site Preparation)
Target Vegetation and Condition
Crop Trees and Condition
Soil Conditions (for Soil-Active herbicides)

3. METHODS

Treatment Method (Aerial, Ground Broadcast, Injection, etc.)

Type of Equipment Used, including Nozzles and Boom Types, etc.

Application Technique: Application Height, Speed, Pressure

4. MIXING OF HERBICIDE SOLUTION

BATCH NO..	HERBICIDE	ADDITIVE	CARRIER	TOTAL (L)

State Source of Water for Mixing

5. HERBICIDE APPLICATION

UNIT NO.	HECTARES TREATED	SPRAY MIX USED (L)	RATE kg a.i./ha	RATE % Product

6. WEATHER RECORDS

READING TIME	OPERATIONS Start	OPERATIONS Finish	TEMP. (°C)	RH (%)	CLOUD (% Cover)	WIND km/h & direction

Indicate Dew, Fog, Frost, and Snow Conditions. State Weather Problems.

7. OTHER COMMENTS

RECORD OF HERBICIDE: Received Used

EMPTY CONTAINER DISPOSAL: Number Method Location

ACCIDENTS & FIRST AID:

HERBICIDE SPILLS: Date Amount Location

EQUIPMENT MALFUNCTION:

8. RECORDER'S SIGNATURE

I CERTIFY THAT THE ABOVE SUMMARY IS ACCURATE AND TRUE

Record Keeper's Signature **Name (Print)** **Pesticide Applicator's Certificate No.**

HERBICIDE PROJECT: MONITORING CHECKLIST FOR HERBICIDE TREATMENT ACTIVITIES

Items	Aerial Spraying	Spot Gun (Soil Spraying)	Cut & Bark Treatments	Ground Broadcast Spraying	Roadside Spraying
* Compliance with Label Instructions					
* Protective Clothing & Equipment					
* First Aid & Spill Kits					
* Mixing & Loading Site					
* Calibration of Application Equipment					
* Spray Equipment Safety & Performance; e.g. system leaks					
* Mixing of Herbicide					
* Water (Carrier) Quality					
* Loading of Herbicide					
* Weather Conditions Compliance					
* Rate of Application					
* Maintenance of Buffer Strips & Pesticide Free Zones					
* Droplet Size & Distribution					
* Spray Coverage: Skips & Misses		N/A	N/A		
* Flight Pattern		N/A	N/A	N/A	N/A
* Flight Time		N/A	N/A	N/A	N/A
* Treatment Height (above vegetation)		N/A	N/A		
* Total Amount of Herbicide Used					
* Pesticide Spills					
* Storage and Handling of Herbicide					
* Container Disposal					
* Mixing and Loading Site Clean-up					
* Treatment Records					
* Compliance with Contract Conditions					
* Compliance with Permit or Approved Pest Management Plan					
* Compliance with Pesticide Control Act					
* Compliance with Forest Practices Code					
* Additional Conditions					
N/A - Not Applicable					

POST-TREATMENT EVALUATION: TREATMENT EFFECTIVENESS CHECKLIST

1. ADMINISTRATION AND AREA IDENTIFICATION

- Region ☐
- Opening No./Map Reference ☐
- District ☐
- Licensee ☐
- Location ☐
- Biogeoclimatic Zone/Subzone ☐
- Vegetation Complex ☐
- Pesticide Use Permit/Pest Management Plan Approval No. ☐

2. TREATMENT OBJECTIVE:

- State the Objective of the Treatment: e.g. Site Preparation, Crop Tree Establishment and Growth ☐

3. METHODS AND TECHNIQUE USED:

- Herbicide Application Technique: Include Equipment, Herbicide Product, Carrier and Additive used, Application Rate, Treatment Time, etc. ☐
- Assessment (Evaluation) Method: Walk-through, Sample Plots, Aerial Viewing, etc. ☐

4. TREATMENT EFFICACY AND OTHER COMMENTS

- List of Target Vegetation Species ☐
- Estimated % Control of the Target Species ☐
- Comment on the Condition of Target Vegetation, e.g. Resprouting ☐
- List of Resistant Species other than the Target species ☐
- Impact on Wildlife Browse ☐
- Uniformity of Coverage; Presence of Skips ☐
- Total Non-Crop Vegetation Increase or Decrease ☐
- Vegetation Shift ☐
- Effect on Non-Target areas, including Buffers, Pesticide Free Zones ☐

5. CROP TREE RELEASE AND GROWTH

- List of Crop Tree Species ☐
- Provide Competition Rating (0-100) of the Crop Trees: Free growing (where Applicable) ☐
- Comment on the Condition/Vigour of Crop Trees, including Herbicide Damage

6. SUMMATION OF EVALUATION

- Comments on Achievement of Objective(s) ☐
- General Comments, including Appropriateness of the Treatment ☐
- State whether there is a need for follow-up Survey(s) or Treatment(s) ☐
- Other Recommendations ☐

7. EVALUATOR'S NAME, SIGNATURE, POSITION, AND DATE OF THE ASSESSMENT ☐

Notes:

SECTION E

FIRST AID AND PERSONAL
PROTECTIVE GEAR: FOR HERBICIDE USE

FIRST AID KIT: HERBICIDE USE

THE FOLLOWING MATERIALS LISTED BELOW ARE SUGGESTED.

MATERIALS	PURPOSE
• Detergent or pure soap	• To wash herbicides off the skin.
• Rubbing Alcohol	• To wash skin after soap and water wash
• Scrub brush	
• Nail file	
• Skin lotion	
• Paper towels	
• Lemon juice or vinegar	• To neutralize basic or alkaline chemicals if swallowed
• Baking soda or milk of magnesia	• To neutralize acidic chemicals if swallowed
• Syrup of Ipecac (or salt)	• For inducing vomiting, **only on the advice of a physician.**
• Activated charcoal	• To mix with water and swallow to act as herbicide absorber, **only on the advice of a physician.**
• Clean water	• For affected person to drink, or to mix with activated charcoal or to flush herbicides from eyes and/or skin.
• Collapsible water container	
• Cups	• For drinking
• Plastic face-mask	• To avoid direct contact with a pesticide-contaminated person's mouth during mouth-to-mouth resuscitation.
• Gloves	• To prevent skin contamination of person who administers first aid.
• Band-Aids, adhesive tape and bandages (sterile gauze pads to place over affected areas)	• To keep affected areas clean after administering basic first aid.
• Roller and triangular bandages	• To hold dressings in place or to make an armsling
• Eye patches	
• Eye washes	
• Teaspoon, tongue blades (wooden sticks)	• For measuring and mixing charcoal; splinting
• Scissors and safety pins	• Cutting and holding dressings in place
• Thermometer	• For checking affected person's temperature
• Tweezers	
• Icebag or chemical icepack	
• Change of clothing	
• Blanket	• To cover the chemically exposed person.
• Provision of wash & cleanup area	

FIRST AID KIT: HERBICIDE USE *(CONTINUED)*

MATERIALS	PURPOSE
• Herbicide label(s)	
• Herbicide(s) Material Safety Data Sheet	
• First Aid Manual	
• Pencil and pad.	• To document time and symptoms of person exposed
• Coins, cellular phone and/or radios (with extra radio batteries)	• For making calls to emergency response agencies
• List of emergency phone numbers	• To contact emergency response services: e.g. physicians and Poison Control Centre, pesticide manufacturers
• Flashlight with extra batteries in a separate bag	

Notes: 1. First Aid Kit should be carried to the project site.
2. Any person regularly involved in applying pesticides should have a routine medical examination.

GENERAL FIRST AID PROCEDURES FOR HERBICIDE USE

GENERAL

1. Act immediately and quickly with extreme thoroughness. Speed is important in reducing injury.
2. Wear appropriate protective clothing and equipment.
3. Stop the exposure by removing the affected person from the source of exposure.
4. Administer the appropriate first aid, artificial respiration etc.
5. Remove contaminated clothing.
6. Transport the victim, with a readable label or the name of the chemical, to a doctor or hospital emergency room.

EXPOSURE

1. Skin Contact

- Remove contaminated clothing immediately.
- Scrub the contaminated area vigorously with soap and water. This includes skin, hair, fingernails and toenails.
- Wash contaminated area with rubbing alcohol.
- Rinse with clean water.
- Dry person, and wrap in blankets or put on complete change of clean clothing.
- Transport person for medical treatment.

2. Eye Contact

- Hold eyes open, wash eyes with gentle stream of clean (chemical or drug free), running water for 15 minutes or more.
- Use copious amounts of water.
- Person should receive medical attention.

3. Inhalation

- If victim is in enclosed space, do not go in after him without air-supplied respirator.
- Carry person (do not let him walk) to fresh air immediately.
- Loosen all tight clothing.
- Apply artificial respiration if breathing has stopped.
- If patient is convulsing, monitor his breathing, ensure that he does not strike his head on the wall or floor, and keep his chin up to unblock his air passage.
- Keep person wrapped in a blanket to prevent chilling, and as quiet as possible while being taken to medical attention.

4. Ingestion

- Call a physician immediately.
- Check the label to see if vomiting is recommended, or an antidote should be administered.
- If vomiting is recommended, induce vomiting unless the person is unconscious, or convulsing.
- Vomiting can be induced by tickling the back of the throat with a clean finger, or drinking 2 tablespoons of salt dissolved in a glass of warm water.

EXPOSURE TO SELECTED HERBICIDE PRODUCTS: SPECIFIC FIRST AID INSTRUCTIONS

When calling physician, Poison Control Centre or taking patient to hospital, have pesticide container available.
When flushing skin or eyes use plenty of running water and continue for at least 15 minutes. For eye washes to be effective, eyes must be (held) open.
Never induce vomiting or give anything by mouth to patient who is unconscious and/or having convulsions.

	Asulox F (Asulam)	**Forestamine® (2,4-D Ester)**	**2,4-D amine 500®** (2,4-D amine)**	**Glowon® (M.S.M.A.)**	**Release® (Triclopyr ester)**
INHALATION	Remove person from contaminated area to fresh air. If breathing stops administer artificial respiration. Get medical attention.	Remove person to fresh air. If adverse effects continue, get medical attention.	Remove person to fresh air. If adverse effects continue, get medical attention.	Remove person to fresh air. If breathing is difficult, administer oxygen. If breathing stops administer artificial respiration. Get medical attention.	Remove person to fresh air. If adverse effects occur, get medical attention.
SKIN CONTACT	Wash exposed skin. Remove contaminated clothing, wash skin with soap and water.	Remove contaminated clothing. Flush skin with plenty of water.	Remove contaminated clothing and shoes. Flush skin with water.	Remove contaminated clothing. Wash skin and hair thoroughly with soap and water. If irritation persists, get medical attention.	Wash affected area with plenty of water. Get medical attention if irritation develops.
EYE CONTACT	Immediately flush eyes with plenty of water. Get medical attention.	Immediately flush eyes with plenty of water. Get medical attention.	Immediately flush eyes with plenty of water. Get medical attention.	Flush with running water holding eyelids open to flush out material. Get medical attention.	Flush eyes immediately with plenty of water, and continue flushing for 15 minutes.
INGESTION	If person is conscious, wash out mouth. Get medical attention.	Do not induce vomiting. Get medical attention immediately.	Induce vomiting immediately by giving 2 glasses of water and sticking finger down throat. Repeat until vomit fluid is clear. Get medical attention.	Drink 1-2 glasses of water and induce vomiting. Keep head higher than chest to prevent aspiration. Get medical attention.	Do not induce vomiting. Get medical attention and/or transport to an emergency facility.

**** Instructions same for Estasol® LV 600, For-ester® and Esteron® 600***
***** Instructions same for Forestamine® and Formula® 40F®***

EXPOSURE TO SELECTED HERBICIDE PRODUCTS: SPECIFIC FIRST AID INSTRUCTIONS *(CONTINUED)*

	Simazine 80W® (Simazine)	**Tordon 22K® (Picloram)**	**Velpar L® Pronone 10G® (Hexazinone)**	**Vision® (Glyphosate)**	**Weedone CB® (2,4-D; 2,4-DP)**
INHALATION	Remove person to fresh air. If breathing is difficult, administer oxygen. If breathing stops, give artificial respiration. Get medical attention.	Remove person to fresh air. If breathing is difficult, give oxygen. If breathing stops give artificial respiration. Get medical attention.	Remove person to fresh air if breathing is difficult, give oxygen. If breathing stops, give artificial respiration. Get medical attention.	If breathing stops start artifical respiration. Get medical attention.	Remove person away from product or smoke to fresh air. Get medical attention immediately.
SKIN CONTACT	Remove contaminated clothing. Wash skin and hair thoroughly with soap and water. If irritation persists get medical attention.	Wash affected area with plenty of water. Get medical attention if irritation develops.	Remove with plenty of water. Wash skin (and hair, in case of Pronone 10G®) thoroughly with soap and water. If irritation persists get medical attention.	Flush skin with plenty of water.	Remove contaminated clothing. Wash skin immediately with plenty of soap and water.
EYE CONTACT	Immediately flush eyes with plenty of water. Get medical attention.	Immediately flush eyes with plenty of water. Get medical attention.	Immediately flush eyes with plenty of water. Get medical attention.	Immediately flush eyes with plenty of water. Get medical attention.	Irrigate eyes with water and continue for 15 minutes. Get medical attention.
INGESTION	Drink 1-2 glasses of water and induce vomiting. Keep head higher than chest to prevent aspiration into the lungs. Get medical attention immediately.	Have person drink 1-2 glasses of water and then induce vomiting. Get medical attention immediately.	Drink 1-2 glasses of water and induce vomiting. Keep head higher than chest to avoid aspiration into the lungs. Get medical attention immediately.	Do not induce vomiting. Drink copious amounts of water, milk or any potable liquid. Get medical attention.	Do not induce vomiting. If person is conscious give 2-3 glasses of water to drink. Get medical attention.

Source: Manufacturers' Labels and Material Safety Data Sheets.

SYMPTOMS OF EXPOSURE FOR SELECTED HERBICIDES

Asulam (Asulox F)
Eye and skin irritant.
Overexposure may cause erythema (skin redness)

2,4-D
Skin, eyes, nose and throat irritation.
Dizziness or giddiness (vertigo), headache.
If ingested: burning of mouth, esophagus, and stomach leading to nausea, vomiting and diarrhea.

Glyphosate (Vision®, EZ-JECT® Capsules)
Eye irritation and conjunctivitis, dermal irritation. If ingested: gastrointestinal discomfort, nausea, vomiting and diarrhea.

Hexazinone (Velpar L®, Pronone®)
Eye, nose, throat and skin irritation.
Overexposure - abnormal liver function.

MSMA (Glowon®)
Irritates eyes, nasal passages, throat and skin.
Overexposure: Salty taste, garlic-like breath, burning throat, headache, dizziness, stupor, diarrhea, intestinal pains, and in severe cases, convulsions, paralysis and death.

Picloram (Tordon®)
Severe eye and skin irritation.
Prolonged skin contact may cause burn.
Repeated excessive exposure affects liver.

Simazine (Princep Nine-T®)
Irritates eyes, nasal passages, throat and skin.
Overexposure causes drowsiness and irregular respiration.

Triclopyr (Release®)
Slight temporary eye irritation.
Skin irritation and/or allergic reaction.
Irritation of respiratory tract if inhaled.
Large amounts ingested, followed by aspiration may cause lung damage.
Kerosene in the product can affect central nervous system.

RECOMMENDED TYPES OF PROTECTIVE CLOTHING AND EQUIPMENT FOR HERBICIDE USE

This guide applies to all herbicides (e.g. 2,4-D amine, 2,4-D ester, glyphosate, hexazinone, simazine, asulam, MSMA and triclopyr ester) which are currently registered for use on forests and woodlands in Canada. Protective clothing and equipment must ensure that operators are not exposed to harmful quantities of herbicides due to drift, contact with sprayed foliar surfaces, spillage or other sources of exposure.

PROTECTION	RECOMMENDED CLOTHING AND EQUIPMENT
HANDS	Chemical resistant unlined plastic (nitrile or neoprene) gloves, long enough to protect wrist. Cuff of the gloves must be turned up to form a cup to trap any liquid that can run down arm when working with hands in upward position. Rinse gloves before removal.
FEET	Water resistant boots over socks. Knee high boots preferred. Unlined rubber boots should be used when mixing or handling concentrates. Leather or canvas footwear should not be used.

RECOMMENDED TYPES OF PROTECTIVE CLOTHING AND EQUIPMENT FOR HERBICIDE USE *(CONTINUED)*

PROTECTION	RECOMMENDED CLOTHING AND EQUIPMENT
WHOLE BODY	

FACE
Chemical resistant splash goggles, face shield or chemical safety glasses. Face shield is preferred if you wear glasses.

HEAD AND NECK
Water/oil resistant hood or full wide brimmed hat. Cloth sweatbands, headbands or liners, and baseball caps should not be used as they absorb herbicides. Though the use of a hard hat may be discretionary for some herbicide activities, British Columbia Worker's Compensation Board (WCB) requires that "safety headgear shall be worn by workers in all areas in which a potential hazard to the head exists from falling, flying, or thrown objects or from harmful contacts".

BODY
Long-legged pants and jackets. The general recomendation is to use waterproof or oil-proof materials (depending upon the chemical or spray mix used). However, for some ground spray operations, pants and jackets or long sleeved shirt made of cotton/polyester mix are accepted as a minimum.

Clean, impervious coverall or full-length chemical apron worn over normal work clothes (long sleeved shirt and long pants). Coverall may be used instead of a combination of Pants and Jackets. A chemical apron may be used for chemical handling, mixing and filling or cleaning of equipment.

HEARING
Ear protectors are essential where motorized equipment leads to excessive noise.

RESPIRATORY SYSTEM	

Filtering facepiece respirator. Where a respirator is required or requested, a respirator with a well fitted facepiece equipped with a filter pad is adequate for droplets of water solutions of herbicides provided that no chemical vapours arise from the water solution droplets. When chemical vapours are released from solutions of herbicides (e.g. oil spray), or if the herbicide has an objectionable odour, the respirator must be fitted with a filter and an organic vapour cartridge.

Notes:

MINIMUM PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT REQUIRED FOR HERBICIDE OPERATIONS

OPERATION	Equipment Used	Gloves	Face Shield or Goggles	Socks & Boots	Pants*	Jacket*	Hood or Hat	Respirator	Ear Protector
Handling, loading, mixing and filling	All Types	E	E	E	E	E	E	E1	n/a
Solid Materials (granules, crystals dust) applications	1. Gravity/ Placement	E	D	E	E2	D	D	E1	n/a
	2. Motorized	E	E	E	E2	D	D	E	E
Medium Volume Spraying	Backpacks	E	D	E	E2	E2	D	E3	n/a
Low Volume Spraying	Motorized Mistblowers	E	E	E	E	E	E	E3	n/a
Ultra Low Volume Spraying	Herbi and Spot Herbi	E	E	E	E	E	E	E3	n/a
Spot Application	Spot Guns	E	D	E	E2	E2	D	D	n/a
Spraying with vehicle mounted fixed boom	1. Tractor/truck	E	E	D	E2	E2	E	D	E
	2. Tractor without cab	E	E	E	E	E	E	E	E
Spraying with gun and hose pulling (handling)	Vehicle Mounted Sprayers	E	E	E	E	E	E	D	D
Basal Bark Treatment	All Types	E	E	E	E	E	E	D	n/a
Tree Injection	1. Hack & Squirt	E	D	E	E2	E2	D	D	n/a
	2. Lance (Liquid)	E	D	E	E2	D	D	D	n/a
	3. Capsule or shell	E	D	D	D	D	D	n/a	D
Ground marking /flagging (aerial)	Aircraft	E	E	E	E	E	E	D	D
Flying (pilots)	Aircraft	D	D	D	D	D	D	n/a	D
Exiting from aircraft cockpit	Aircraft	D	D	D	D	D	D	n/a	n/a
Exiting from cab	Spray Vehicle	E	D	E	E2	E2	D	n/a	n/a
Empty container rinsing, handling and disposal	All types	E	E	E	E	E	D	D	n/a

MINIMUM PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT REQUIRED FOR HERBICIDE OPERATIONS *(CONTINUED)*

OPERATION	Equipment Used	Gloves	Face Shield or Goggles	Socks & Boots	Pants*	Jacket*	Hood or Hat	Respirator	Ear Protector
Equipment cleaning, maintenance, and repair	All types	E	E	E	E	E	D	D	n/a
Re-entry to spray area before spray is dry	All types	E4	E4	E	E2	E2	E	D	n/a

Notes:

D Desirable, but not necessary at all times. Should be used when there is noticeable exposure to herbicides or excessive noise.

E Essential in relation to working conditions in forestry.

E1 Respirator to be used when handling or applying powders, dusts, crystals or granules. Respirator may also be required under certain circumstances of handling, loading, mixing, filling and applying undiluted liquid herbicides when there is a likelihood of herbicide inhalation. Respirator not required for normal use and handling of diluted spray materials.

E2 Pants, jacket/long sleeved shirt made of cotton/polyester mix material essential as minimum for operator protection in low brush situations.

E3 Respirator to be used when spraying herbicides in an enclosed space. Respirator may also be required when there is a likelihood of herbicide inhalation.

E4 Essential for high brush site. Discretionary for low brush situation if spray droplets are settled.

n/a Not applicable.

***** Coveralls may be used as a replacement for pants and jacket.

Additional Notes:

- When the applicator is operating from an enclosed aircraft cockpit or an enclosed vehicle compartment to which forced air ventilation units complete with approved spray filter have been fitted, then none of the listed items need be worn when spraying herbicides.
- The contractor or his designated authority (e.g. Project Supervisor) is responsible for ensuring that these safety requirements are met.
- Herbicide label restrictions take precedence over the recommendations in this table when label restrictions are more limiting.

CLEANING RECOMMENDATIONS FOR PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Material	Immediately After Contamination	After Each Day's Work
A. Gloves	Contamination with undiluted herbicide should be thoroughly washed with water within 10 minutes.	1. Wash inside and out with soap or detergent and water. 2. Rinse thoroughly with clean water. 3. Check for leaks in the gloves. Fill gloves with clean water and squeeze. Any glove that leaks should be discarded. 4. Wipe usable (i.e. good) gloves inside and out and allow to dry thoroughly. Avoid direct sunlight and extreme heat when drying. 5. Wash hands again.
As a good safety practice, gloves must be rinsed thoroughly before taking them off. Wash your hands again following glove removal.		
B. Rubber Boots	Wash off with water.	1. Wash outside (part of boots) with water. 2. Allow inside and outside of boots to dry.
C. Water or oil proof pants, jackets and coveralls	Grossly contaminated areas should be rinsed well with water only. If contamination is with herbicide concentrate, remove clothes immediately and wash before re-use. (NB: neoprene material may become swollen and tacky with soapy water and some herbicides.)	1. Wash with soap and water.
D. Respirators		1. Take out the filtering elements. 2. Clean respirators with warm water and mild detergent. Rinse and air dry. 3. Sterilize after cleaning with household disinfectant.

Notes:

- Do not attempt to wash disposable chemical respirators, gloves or clothing.
- Rubber gloves must be used for all washing procedures.
- Take care when removing contaminated material or clothing to avoid secondary skin contact.
- Consider all clothing worn while handling, mixing or applying pesticides as contaminated.
- Leather materials (e.g., belts, wristbands and boots) when contaminated by concentrates should be appropriately discarded.

Notes:

PROCEDURE FOR LAUNDERING HERBICIDE CONTAMINATED CLOTHING

GENERAL

1. Always include a laundry plan with your herbicide use activity. Plan on laundering clothes after each day's herbicide use.
2. Clothing worn while handling, mixing, or applying herbicides should be considered contaminated.
3. Read the herbicide label before you start laundering contaminated clothing.
4. Handle pesticide contaminated clothing with rubber gloves, and store the clothing in disposable plastic bags prior to washing.
5. Work clothes should be placed in an area separate from other laundry items.
6. Wash contaminated laundry as soon as possible since residues are easier to remove when not allowed to dry.
7. Washing of laundry is necessary at the end of each day's herbicide use after the application equipment has been cleaned and stored.
8. Use heavy duty or phosphate-based detergent. Do not use bleach and ammonia. They are ineffective in removing pesticide contamination. (Bleach and ammonia react to form a poisonous chlorine gas).
9. Use disposable clothing to provide extra protection during washing of clothing containing herbicide residues.
10. If the clothing other than rubber boots or gloves is thoroughly contaminated, do not wash it. Discard it in the appropriate and safe manner. Such clothing cannot be completely cleaned.
11. Always keep contaminated clothing separate from "normal" family or home laundry before, during and after washing.
12. Wash only a few items of clothing at a time. Avoid overloading the washing machine.
13. You may wish to apply starch to your clothing as an added protective measure. The starch finish can help prevent pesticide transfer to the skin.

STEPS

1. Use a pre-wash additive on contaminated areas.
2. Pre-rinse or pre-soak in a suitable container (washer, tub, or bucket) or by spraying clothing outdoors in a safe manner with a hose.
3. Agitate in an automatic washing machine.
4. Wash with plenty of hot water. Set laundry machine at the hot (60° C) and full water levels, and normal (12 minute) washing cycle.
5. Repeat washings twice or thrice.
6. Line dry washed laundry. To avoid contamination do not use automatic dryer.
7. Cleaning of washing machine after use:
   - Rinse the washing machine thoroughly after laundering contaminated clothing. The machine must be run empty (without laundry) at the same settings (hot water, full tub, normal setting) and detergent used to launder the clothes.
   - Wipe the inside with rubbing alcohol (isopropyl alcohol) for added protection.

Reference:

Easley, Carol Bryan, Joan Laughlin and Roger Gold. 1984. Laundering Pesticide Contaminated Clothing. Pennsylvania Flower Growers Bulletin. Jan. 1984. pp. 15-16

SECTION F

HERBICIDE USE SAFETY PRECAUTIONS:
MIXING, APPLICATION, STORAGE,
TRANSPORTATION
AND CONTAINER DISPOSAL

HERBICIDE USE SAFETY: GENERAL

Before beginning, make sure your protective equipment is appropriate for the activity.
Have spill containment equipment and a spill clean-up plan at the mixing, loading and storage sites.
Have emergency wash facilities, first-aid equipment and emergency phone numbers close at hand.

1. Read the pesticide label, including the small print and follow (double-check) its recommended safety practices.
2. Inspect herbicide containers for leaks prior to handling them.
3. Once pesticide containers have been handled, the handler should not touch any part of their body, especially the eyes, to avoid personal contamination.
4. Never work alone when handling highly toxic chemicals. (Check warning sign on the label.) A minimum of one person with a Pesticide Applicator's Certificate will be on the project at all times.
5. Always have plenty of clean water, soap and towels, and a change of clean clothes available.
6. First Aid Equipment must be readily available when handling herbicides.
7. Wear the appropriate personal safety clothing and equipment for the intended job. This may include rubber boots, chemical resistant aprons, coveralls, gloves, a face shield and a hat.
8. Know the limitations of protective clothing and equipment being used.
9. Practice good personal hygiene. Rinse gloves before removal and wash hands well with soap and water before smoking, handling food and drink, or attending to personal needs. No person (applicators or bystander) should eat, drink or smoke while applying, mixing or handling herbicides.
10. Remove protective clothing after use or when contaminated, and wash well before eating and drinking.
11. Discard heavily drenched or contaminated clothing or faulty protective covering, especially leaky gloves. Shower or clean up thoroughly, particularly the finger nails and hair.
12. Do not store any herbicide product or empty herbicide containers near food or drink.
13. Take a hot shower or bath using plenty of water and soap after work each day.
14. Clean up spilled chemicals at once.
15. Avoid skin and eye contact. Avoid breathing mist if generated. Provide eye fountain near work place.
16. Remove contact lenses before entering areas with chemical vapours.
17. Repair any leak in the spray distribution system or in the mixing equipment as soon as it is detected. Never blow out clogged nozzles or hoses with your mouth.
18. Select the correct equipment for the intended use.
19. Take only the necessary quantities of herbicide to the field.
20. Store herbicides in a dry and secure place in the field. (Never leave herbicides unattended or unlocked.)
21. Do not transfer herbicides into other containers such as beer and soft drink bottles.
22. Select sites for storage, loading, and cleaning of equipment that will prevent contaminating streams, ponds, cisterns, food stocks, crops adjacent to work sites, or other non-target areas. Never allow puddles or pools of herbicide to form.
23. Pick up and safely dispose of (or deliver to pickup depot) all empty herbicide containers immediately after use. Never stand in the smoke of burning herbicide containers.
24. Keep children or other unauthorized persons, pets and livestock out of the mixing, loading or storage sites, and areas in which application is in progress.
25. Sign the herbicide treatment area to inform people or prevent them entering the site.

MIXING OF HERBICIDES

1. Ensure that the appropriate clothing and equipment are used.
2. When handling concentrated or highly toxic material, it is important to wear the following protective equipment: clean and well-fitted goggles, full brim water-repellent hat, face shield or respirator, rubber gloves, coveralls, rubber boots and full length apron.
3. Mixing must be done or supervised by a certified person(s). For aerial herbicide applications, mixing should be done by someone other than the pilot.
4. Use the proper mixing equipment.
5. All measuring and mixing containers should be reserved solely for these purposes.
6. Calculate accurately the correct quantity of the herbicide product needed. Always add the concentrate to the carrier - Never the carrier to the concentrate.
7. Do not rush through the mixing process. Spills can occur if you are in a hurry.
8. Do the pouring, measuring and mixing outdoors under low wind conditions.
9. Check wind direction. Always stand upwind (back to wind) when mixing. To reduce airborne dust, pre-mix wettable powders with a small amount of water before addition to the mixing tank.
10. Indoor mixing or loading must be done only in areas with adequate lighting and ventilation.
11. Use a proper tool, (e.g. a sharp knife) when opening paper and plastic containers. Do not tear with hands. Clean the tool (knife) after use.
12. All containers should be carefully opened on a stable surface to prevent tipping or spillage.
13. Always keep containers below eye level when pouring herbicides.
14. Stand with your head well above the spray tank's fill hole when pouring herbicide into a mixing tank.
15. Pour carefully to avoid splashing.
16. Do not point container spout towards the face when opening containers.
17. Keep the discharge end of the fill hose above the water level in the spray tank to prevent back-siphoning of pesticides into water supply. Do not use hoses to directly fill sprayers from municipal wells, standpipes, reservoirs or cisterns.
18. Attend to sprayer tanks. For solids/powders, tap herbicide container when filling to avoid overflowing and spilling of herbicides on the ground.
19. Rinse empty liquid containers three times into spray tanks.
20. For solids/powders, tap sides of paper bags to ensure that any remaining wettable powder falls into the spray tank.

Notes:

INCOMPATIBILITY OF SELECTED HERBICIDES WITH SPECIFIC MATERIALS

2,4-D
Incompatible with acids, bases and oxidizing materials

Glyphosate (Vision®, EZ-JECT®, Capsules)
Incompatible with galvanized or unlined steel (except stainless steel) containers or spray tanks. Vision® reacts with steel and the resulting gas mixture can flash, ignite or explode. **Vision® should be mixed and applied only in a stainless steel, aluminum, fibreglass, plastic and plastic lined containers**
Incompatibility of EZ JECT®, capsules unknown

Triclopyr (Release®)
Incompatible with strong acids, bases and oxidizing materials

Simazine (Princep Nine-T®)
Incompatible with strong acids and bases

Hexazinone (Velpar L®, Pronone 10G®)
Incompatible with strong acids and bases

MSMA (Glowon®)
Bases; arsenic in the presence of acids, may react with metals, such as aluminum, zinc, copper or tin to form arsine gas. Strong reducing agents (aluminum, copper or galvanized metal containers).

Picloram (Tordon®)
None under normal condition but under abnormal conditions oxidizing materials, strong acids, halogenated organics, brass, copper, aluminum and zinc (including galvanized metals) should be avoided.

Notes:

AERIAL HERBICIDE APPLICATION

General Safety Precautions

1. Arrange spraying schedules so that poor visibility before and shortly after sunrise will not seriously affect the safety of the operation.
2. Do not permit spraying upgrade when the climb required exceeds one-half the climbing ability of the helicopter.
3. Ensure that all reconnaissance flights are performed with spray tanks empty, and at an altitude of not less than 90 metres above the ground.

Personnel Safety (Aircraft)

1. Unless authorized by the pilot, stay away from a helicopter when rotor blades are in motion. Stay at least 15 metres away from small helicopters, and 30 metres away from large helicopters.
2. When within 15 metres of the helicopter, approach or leave from front or side near front and within view of the pilot.
3. Never approach or leave the helicopter from any side where ground is higher.
4. Stay away from tail rotor at all times, and see that others do likewise.
5. Place caution signs on approaches to active heliports/airstrips.

Pilot Safety

The pilot:

1. Should be cautioned about snags and standing trees, location of downdrafts, and telephone and hydro lines.
2. Must not fly in fog, heavy rain, before daylight or after dark.
3. Should ensure that a wind indicator of plastic ribbon or similar material is placed near each heliport. The target area and surrounding area should be checked for drift hazards before application.
4. Is responsible for the safety of the aircraft, its occupants, and cargo. The pilot must not fly in a manner or at a time which may create a hazard, even if the employer insists.
5. Should make a preflight aircraft check.
6. Should avoid flying through spray or drift if possible.
7. Shall not apply herbicides over flagcrew or other persons.

Ground Crew

1. Loaders should wear rubber gloves, high rubber boots, face shield or goggles, full brim water-repellent hat, coveralls and full length rubber apron.
2. Close tanks and hoppers tightly after filling to prevent spillage in the event of an accident.
3. Should not stand in pesticide-contaminated run-off water.
4. Clean aircraft, especially the cockpit, frequently.
5. Should be on site until spraying is completed so that help can be given to the pilot in case of accident.

Flagcrew

1. Should wear waterproof hat, jacket, long pants, rubber gloves and boots, and an eyeshield.
2. Should move over to the next position when the aircraft is lined up for a pass.
3. Should avoid turning his back on an approaching aircraft.

(Use of permanent markers, automatic flag systems and Navigation Systems (e.g. Global Positioning System - G.P.S.) are recommended instead of using flagcrew. They eliminate the possibility of harm to flagcrew).

GROUND VEHICLE APPLICATION

1. While applying herbicide, do not cross open water (streams, ponds etc.) with ground spray equipment.
2. Thoroughly clean and rinse spray equipment after project completion.

See also Backpack Application Below.

HACK AND SQUIRT APPLICATION

1. All crew members should receive orientation on the use, handling, and application of the chemical, care of the applicator equipment, along with on-the-job training.
2. All contacts with the chemical (accidental spillage), must be reported to the supervisor.
3. Unlined rubber gloves should always be worn when applying herbicide.
4. Hands must be washed with soap and water prior to smoking, chewing gum or eating and at the end of the day's work. A complete change of clothing should be made daily.
5. All paper towels used after washing will be placed in a plastic bag for disposal.

BACKPACK APPLICATION

1. All crew members should receive instructions on the mixing, loading and application of the chemical, equipment maintenance, and safety gear.
2. All crew members should be informed of the boundaries of the treatment area, including buffer zones surrounding streams, lakes and other bodies of water.
3. It is recommended that a hard hat with face shield, rubber boots, unlined rubber gloves and waterproof coveralls (or long pants and jacket) be worn.
4. Sprayers and hoses should be checked for leaks.
5. Inhalation of spray mist and any contact with the herbicide should be avoided.
6. Proper calibration of the equipment is necessary.
7. Drift of the spray outside the treated area is to be avoided. Do not spray if wind speed exceeds 8 km/hr.

VISITORS

1. Keep visitors to the project site in a safe area.

HERBICIDE USE SAFETY: STORAGE OF HERBICIDES

GENERAL

It is necessary that herbicides be stored in a safe, secure (under lock and key), and well marked area.

- The storage building should be located in an area not prone to flooding.
- The building should be constructed with fire-resistant material.
- Fire extinguishers must be installed.
- A current inventory of the stored herbicides should be maintained at a separate location, so that in the event of a fire, firecrew will be able to determine what materials are involved.
- Local fire services and other emergency response agencies should be notified of the contents of the herbicide storage facilities. Highly flammable materials must be kept away from the storage area.

STORAGE OF HERBICIDES

1. The storage area (building) should be well ventilated, and protected from direct sunlight, excess heat (including sparks and fumes) or freezing temperatures. The storage area should be equipped with a sump for handling minor spills and leakages. An earthen dike or similar structure may be constructed around the building to contain large spills or run off (in the event of a fire).
2. A minimum of 1 m clearance between the top of herbicide stored and heating units or sprinkler heads should be maintained.
3. All storage areas should have warning signs posted on the front and side walls, identifying a herbicide storage facility.
4. Cupboards separate from the herbicide storage area should be available for the storage of:
   - Personal protection equipment (clothing, boots, gloves, respirators)
   - First Aid Kit
   - Spill Kit
   - Containers used in the mixing operation
   - Hand-operated and power-operated equipment
5. Emergency shower and eye wash station should be nearby.
6. Avoid eating, drinking, smoking or use of any tobacco products in the storage area.
7. Herbicides should never be stored near food, feed, seed, fertilizers, drugs, water supplies, gasoline and solvents or with any other pesticides.
8. Always store herbicides in their original, (tightly sealed) labeled container. Containers holding unused diluted material must be labeled.
9. Other containers especially old food containers or bottles should not be used to store herbicides. Make sure herbicide storage containers do not have holes, loose lids, tears or weak seams.
10. Check containers periodically for leakage, spillage, corrosion, tear, or other signs of deterioration. If faulty containers are detected, transfer the contents to another properly labeled container and safely dispose of the faulty container.
11. Maintain contingency plans and instruct personnel on proper emergency procedures. Keep access to exits clear at all times.
12. Manufacturer's labels, Material Safety Data Sheets, Emergency Response Plans and other leaflets must be retained for reference.
13. Keep all herbicides away from unauthorized people and animals.

SHELF LIFE OF SOME HERBICIDES

HERBICIDE	SHELF LIFE LIMITATIONS
1. Asulum (*Asulox F®*)	Stable. Store at temperatures above 0°C. Do not expose Asulox F® to freezing temperatures.
2. Glyphosate (*Vision®*)	Under normal warehouse storage conditions stable for at least 5 years. Quite stable up to 60°C. Freezes at -27°C but goes into solution after thawing. Heated facilities not required.
(EZ-Ject® capsules)	Stable for several years at normal temperature of use and storage (<35°C).
3. Hexazinone (*Velpar L®*) (*Pronone® 10G*)	Stable under normal temperatures and storage conditions for at least two years. Store above 0°C.
4. Simazine (*Princep Nine-T®*) (*Simazine 80W®*)	Very stable over several years; only slightly sensitive to natural light and extreme temperatures.
5. 2,4-D amine	Insensitive to light and temperature fluctuations; no limitations.
6. 2,4-D ester	Depends on the emulsifying systems. Some retain satisfactory emulsifying properties after three years.
7. MSMA (*Glowon®*)	Stable.
8. Triclopyr (*Release®*)	Stable. Store above -2°C, or agitate container before use.
9. Picloram (*Tordon®*)	Stable under normal storage conditions.
Source: Manufacturers' labels and Material Safety Data Sheets.	

Notes:

HERBICIDE USE SAFETY: TRANSPORTATION OF HERBICIDES

GENERAL:

Some herbicides can present a hazard if they are involved in accidents during transportation. When herbicides are spilled on the roadway, they may catch fire, be scattered by passing cars or trucks, blown by wind onto nearby crops or people, or washed into ditches or streams by rain. If they catch fire, the fumes and smoke may injure firefighters, police, or ambulance personnel. Herbicides may contaminate the vehicle, cargo, or people transporting the chemicals.

When transporting herbicides, the carrier is legally responsible for the safekeeping of the herbicides and all required warning signs. The shipper of the herbicides must comply with regulations respecting the Transportation of Dangerous Goods Acts (TDG), if applicable.

PRECAUTIONS

The following specific precautions should be taken during transportation of herbicides:

1. Herbicides should be transported in the back of a truck (never the passenger compartment), and locked up if unattended.
2. Never allow people and animals to ride in the back of a truck containing herbicides.
3. Food, feed, seeds, drugs or clothing must not be transported in the same compartment as herbicides.
4. Transport herbicides in their original, labeled containers. Should it be necessary to mix herbicides prior to transporting, a licensed applicator should accompany the delivery.
5. All herbicide containers should be secured during transport to prevent spillage.
6. Herbicide containers made of paper or cardboard should be protected from moisture.
7. Herbicide containers made of glass should be protected from breakage.
8. Containers should have the correct labels.
9. Before loading or unloading check containers for damage.
10. Inspect vehicles for herbicide contamination after unloading. Contaminated vehicles should not be allowed to leave.
11. Park the vehicle in shade or move herbicides to shaded area to avoid pressure buildup in the containers.
12. Do not leave vehicles unattended or unlocked.
13. Herbicide first aid and spill kits should be stored in the vehicle and available at all times in the event of an accident.
14. Decks of vehicles used to transport herbicides should be made of or lined with plastic or metal. Install a metal or plastic storage box or lay plastic over the deck.

SHIPPING INFORMATION FOR SOME SELECTED HERBICIDES*

	Asulox F® (Asulam)	2,4-D Ester 600® Esteron® 600 2,4-D LV 600® (2,4-D ester)	Formula 40F® Forestamine 500® 2,4-D Amine 500® (2,4-D amine)	Glowon® (M.S.M.A.)	Princep Nine-T®+ Simazine 80W® (Simazine)
PROPER SHIPPING NAME	Weed killing compound	Environmentally hazardous substance, liquid N.O.S. (2,4-D ester)	Environmentally hazardous substance, liquid (2,4-D amine)	Environmentally hazardous substance, liquid (monosodium methane arsenate)	Environmentally hazardous substance, solid N.O.S. (simazine)
TDG HAZARD CLASS	Not regulated	9.2	9.2	9.2	9.2
PRODUCT IDENTIFICATION NUMBER (PIN) / UN #	NONE	UN 3082	NONE	NONE	UN 3077
TDG LABEL	NONE	NONE	NONE	NONE	NONE
PACKING GROUP	NONE	III	III	III	III
SPECIAL INFORMATION	NONE	NONE	NONE	NONE	Regulated unit: 0.55 kg

* Under the Transportation of Dangerous Goods Act (Canada) (TDG)
NOS.: Not otherwise stated

SHIPPING INFORMATION FOR SOME SELECTED HERBICIDES* *(CONTINUED)*

	Pronone 10G® (Hexazinone)	Release® (Triclopyr ester)	Tordon 22K®. (Picloram)	Velpar L® (Hexazinone)	Vision® (Glyphosate)
PROPER SHIPPING NAME	Weed killing compound	Weed killing compound N.O.S.	Weed killing compound N.O.I.	Ethanol Solution Agricultural herbicide	Weed killing compound
TDG HAZARD CLASS	Not regulated	Not regulated	Not regulated	3.0 (DOT/IMO label 3.3)	Not regulated
PRODUCT IDENTIFICATION NUMBER (PIN) / UN #	NONE	NONE	NONE	UN 1170	NONE
TDG LABEL	NONE	NONE	NONE	Flammable liquid	NONE
PACKING GROUP	NONE	NONE	NONE	III	NONE
SPECIAL INFORMATION	NONE	NONE	NONE	Flash point: 23°C (74°F)	NONE

* Under the Transportation of Dangerous Goods Act (Canada) (TDG)
N.O.I.: Not otherwise indicated.
N.O.S.: Not otherwise stated.
Sources: Herbicide Manufacturers' Material Safety Data Sheets.

HANDLING AND DISPOSAL OF UNUSED HERBICIDES AND EMPTY HERBICIDE CONTAINERS

GENERAL

1. All empty herbicide containers, surplus containers and excess herbicide(s) must be disposed of safely and promptly.
2. Waste chemicals and containers should be considered as potentially hazardous to people handling them, the public and the environment. They must be handled properly.
3. All containers, after being rendered useless (crushed or punctured), should be disposed of at approved landfills or buried in the soil in accordance with federal and provincial laws and regulations:
   - in deep soil and at least 2 - 3 metres from bedrock, where lateral subsurface water movement may occur;
   - on relatively high ground, flat or gently sloping away from any water supply;
   - at least 150 metres away from livestock feeding areas, wells or streams, such that water supplies will not be contaminated.

   Consult also herbicide manufacturers, the Administrator of the *Pesticide Control Act* (B.C. Ministry of Water, Land and Air Protection) or the regional office of the Environmental Protection Service (Environment Canada) for special instructions regarding disposal of specific chemicals.

EMPTY CONTAINERS

Empty containers should be securely held in a proper storage area or building until disposal. A regular system of disposal is necessary. Do not allow empty containers to accumulate. Empty containers must not be reused for other purposes.

"Non Returnable Glass", Plastic and Metal Containers

1. Left-over chemicals in "used" containers should be emptied into the application equipment.
2. Allow container to drain for 30 seconds.
3. Triple rinse or pressure rinse the container with water (or other appropriate carrier). The container should be one-fourth to one-fifth full with the rinse solution for each washing. For each rinse, replace the cap of the container and rotate the container. Invert or tilt the container so the rinse reaches all the inside surfaces. All interior surfaces should be thoroughly rinsed.
4. Place the washings back into the application device (spray tank).
5. Let the container drain for 30 seconds.
6. Apply washings to the treatment area.
7. Do not use container for any purpose. Puncture or crush the container so that it cannot be reused.

Paper or Cardboard Containers

- Should be completely emptied and single rinsed.

"Returnable" ("Refillable") Containers

1. Where applicable send empty returnable containers to the manufacturer/distributor for recycling or dispose them according to federal and provincial laws.
2. Follow manufacturer's instructions regarding handling of returnable containers.
3. Do no rinse, open, or attempt to refill, or destroy the container(s).
4. Empty containers must be delivered to manufacturer's designated collection depot or site.

HERBICIDE USE SAFETY: CLEANING AND STORAGE OF SPRAY EQUIPMENT

GENERAL

- Check the product label for specific cleaning instructions and recommendations for disposing of the rinsings.
- Best cleaning area is in the vicinity of the treatment unit.
- Take care to avoid contaminating food, feed, drinking water supply and other water sources, or injuring non-target plants.
- Wear rubber gloves and other safety gear when decontaminating a sprayer. Do not remove protective clothing until equipment is cleaned and stored.
- Never place nozzles in your mouth to blow through the orifice.
- Sprayers should be thoroughly cleaned immediately after application of each type of pesticide or when there is a buildup of oil in the sprayer, and at the end of the season.
- While cleaning the sprayer at the end of the season, add 10 - 15 litres of light weight oil during the final flushing to leave a protective coating as the water is pumped out.

CLEANING OF SPRAY EQUIPMENT

After use of Oil Based Products

(e.g. triclopyr ester (Release®), esters of 2,4-D and other phenoxy herbicides)

1. Rinse sprayer with kerosene, diesel fuel or a comparable light oil.
2. Fill the tank about one third full of a water and ammonia solution (1 litre ammonia to 110 litres water) provided there are no brass components, or with water and TSP solution (1 cup trisodium phosphate in 110 litres water).
3. Circulate the mixture throughout the system. (See that the agitation system on motorized equipment is working during this operation).
4. Spray some solution through the nozzles and let the remainder stand at least 6 hours before pumping it throughout the nozzles.
5. Remove the nozzles and screens and clean tips and strainers with a soft-bristle brush (e.g. tooth brush). Flush the system twice with clean water.

After use of Wettable Powders, Amines and Water Soluble Liquids

1. Rinse tank with water and detergent solution (1 kg detergent in 180 litres of water).
2. Allow solution to circulate through the system for several minutes before pumping it out. (See that the agitation system on motorized equipment is working during this operation).
3. Remove the nozzles and strainers and clean with a soft bristle brush before flushing the system twice with clean water.

STORAGE OF SPRAYER AFTER CLEANING AND DRAINING

1. Make complete check of the pump and where applicable, the engine before storing the sprayer.
2. Store the sprayer in a clean, dry, locked building, away from children, food and animals.
3. If sprayer is stored outside, remove all hoses, wipe them clean of grease and oil and store them inside where they are less exposed to stretching and cracking caused by moisture and temperature changes.
4. Close the nozzle openings and hose connections with masking tape and seal the hose parts in the pump with a rag to keep out dirt and dust.
5. Remove the nozzle tips and screens and store them in a can or jar of diesel fuel.
6. Release the tension on the drive belt, remove the hoses leading into and out of the casing and remove the drain plug from the bottom of the casing.
7. Preferably, store small hydraulic sprayers upside down with the lid removed to allow complete drainage of the container.
8. For a prolonged period of storage of engines remove the spark plug and pour a small quantity of oil (preferably that formulated with anti-rust additives) into the crank case.

SECTION G

HANDLING EMERGENCY SITUATIONS: PREPARING AND RESPONDING TO EMERGENCIES

DEVELOPING A PLAN FOR AN EMERGENCY: CHECKLIST

- **Establishment of agency/company's internal emergency procedure**
  Determination of the emergencies that the agency/company is capable of handling.
  Designation of emergency co-ordinator and substitutes.
  Assigning responsibilities to staff in case of an emergency: Specific action(s) to be taken by staff members.
  Staff training and regular rehearsals of emergency procedures. This should include safety aspects relating to the use of specific herbicides, symptoms of herbicide exposure or poisoning, first aid and spill kits and their use, and emergency notification procedures.

- **Preparation of an inventory of herbicides in storage or being transported**
  Name of the herbicide products.
  Quantities of each herbicide and where stored.
  Associated information on each herbicide: potential hazards to personnel and the environment (e.g. ground water, fish), pesticide labels, material safety data sheet (MSDS), manufacturers' and other pertinent published data.

- **Acquisition of the appropriate emergency equipment and safety gear**
  Inventory of emergency equipment: spill and first aid kits, fire fighting equipment, etc.
  List of protective gear and equipment needed to handle specific situations for each of the pesticides used.

- **Mapping of storage facility (where applicable), or work (project) site**
  Map describing the location of the storage facility or the herbicide activity work site. Detailed layout plan of the semi/permanent storage facility for herbicides, location of safety gear and equipment, fire alarms, fire extinguishers, escape routes, and main shut-offs for electricity, gas and water.

- **Identification and Listing of Emergency Response Agencies**
  Refer to G2 and G3.

- **Communicating with Emergency Response Agencies**
  The agency/company's herbicide use program and internal emergency procedure. Capabilities should be made known to the local emergency response agencies.

- **Post-emergency action**
  Clean-up, investigations of occurrence, report preparations, insurance claims, etc.

- **Posting and Filing of the prepared Emergency Plan(s)**
  Post (or carry) plans at worksites. File plans internally in your agency/company's record system, and with the appropriate emergency response authorities.

- **Updates of plans**
  Ensure that emergency plans are updated regularly.

EMERGENCY RESPONSE SERVICES, GOVERNMENT AGENCIES AND COMPANY CONTACTS

Agency/Company's In-house Emergency Co-ordinator and Substitutes

Agency/Company Name & Phone #
Agency/Company Address:

Emergency Co-ordinator (facility manager)

Name
Phone number(s):

Emergency Substitute Co-ordinator #1

Name
Phone number(s):

Emergency Substitute Co-ordinator #2

Name
Phone number(s):

General Local Emergency Services

- Police
- Fire Service
- Ambulance
- Local/Nearest Poison Control Centre
- Hospital
- Doctor(s)/health care personnel (knowledgeable about the specific pesticides involved) (names and phones)
- Local Clean-up Contractors involved with pesticide emergencies

Other Local Emergency Services:

Injuries and Fatalities

• Poison Control Centre (British Columbia)	1+800+567-8911
• Canadian Centre for Occupational Health and Safety	1+800+263-8466
• Workers' Compensation Board (British Columbia):	
Richmond Head Office	1+604+273-2266
After hours	1+604+273-7711
Out-of-Town (8:30am to 4:30pm)	(toll free) 1+800+661-2112

Spills, Fires and Transportation Accidents Relating to Chemicals

• Environment: Emergencies (Enforcement & Environmental Emergencies Branch (Victoria)	1+250+356-9302
• Provincial Emergency Program (PEP)	1+800+663+3456
• Provincial Ministry of Forests District (local)	
• Canadian Transport Emergency Centre (CANUTEC) (for advice/information on hazards, response procedures and cleanup): collect call #:	1+613+996-6666
• Transportation Emergency Assistance Program (TEAP)(for on-site services)	1+604+477-8339?
• Spills: Dangerous Goods	Zenith-2667
• Herbicide Manufacturers	(See next page)

PROCEDURE FOR NOTIFYING EMERGENCY RESPONSE AGENCIES *(CONTINUED)*

Chemical Accidents Affecting Electricity and Gas

Electric Power Company (local number)

Gas Company (local number)

Forest Fires

Provincial Forest Service/Department (BC)	1•800•663-5555

Emergency Phone Numbers For Selected Herbicide Manufacturers

Monsanto Canada Inc.

Accidents/Spill	(call collect day or night)	1•515•366-5568
Medical Emergency	(call collect day or night)	1•314•694-4000
CANUTEC	(call collect day or night)	1•613•996-6666

Dow AgroSciences Canada Inc.

Product Information	1•519•339-3711
Emergency	1•800•667-3852

Dupont Canada Inc.

Company Number	1•800•667•3925
Product Information	1•800•387-2122
Transport Emergency	1•613•348-3616
Medical Emergency	1•613•348-3616

Novartis Crop Protection Canada Inc.

Emergency	1•800•267-6351

Nufarm Agriculture Inc. 1•800•334-7577

United Agri Products 1•800•561-8273

Ciba-Geigy Canada Ltd.

Company Office Number	1•905•821-4420
Emergency	1•800•267-6351

Rhone-Poulenc Canada Inc.

Company number	1•905•821-4450
Emergency	1•800•334-7577

Other chemical companies

Cheminova Canada Inc.

Emergency	1•800•228-5635 Ext. 153

OTHER PEOPLE OR AGENCIES TO NOTIFY IN CASE OF AN EMERGENCY

OTHER PEOPLE OR AGENCIES TO NOTIFY IN CASE OF AN EMERGENCY

- Agency/company's own management
- Next of kin of the seriously injured people
- Agency/Company's lawyer, if applicable
- Local media: newspapers, radio and television stations (to inform the public of potential dangers)

PROCEDURE FOR NOTIFYING EMERGENCY RESPONSE AGENCIES

The person reporting an incident should provide the following information to the emergency response services

- Name and phone number of the agency/company/individual involved in the incident
- Reporting person's name and call-back phone number
- Location of the incident
- Type of incident (e.g. pesticide poisoning) and short description of the circumstances of the occurrence
- The chemical(s) (exact name, quantity and hazard class), equipment and other materials involved
- Presence and extent of injuries including exposed person's condition (e.g. breathing), name and age
- Emergency action already taken following the incident
- Potential impact on people and environment within the site of the incident and in the surrounding areas

BASIC PROCEDURES FOR HANDLING HERBICIDE POISONING, SPILLS AND FIRES

Handling Herbicide Poisoning

- Protect yourself from herbicide poisoning by wearing the appropriate safety gear.
- Move the exposed person away from the place of the incident and keep the individual warm.
- Get the description of the incident, including the route of exposure (ingestion, eye, skin, or lungs) from co-workers or exposed person (if conscious).
- Identify the symptom(s) of the poisoning.
- Have approved First Aid Kit ready.
- Provide basic first aid to the individual.
- Contact the Poison Control Centre and other emergency response agencies for advice and emergency action (Check the notification procedure above). Do not leave the exposed person alone. Find someone to make the emergency contacts.
- Transport the exposed person to a hospital. Take technical information on the herbicide (e.g. label, material safety data sheet) with you.
- Contact your appropriate company/agency authorities.
- Prepare a report of the incident for the appropriate agency.

Handling Herbicide Spills and Leaks

- Contact agency/company emergency co-ordinator or substitute of the location, size and the extent of the spill.
- Notify the appropriate emergency response services e.g. local fire department, police, etc.
- Wear the appropriate safety gear and equipment to protect yourself from pesticide poisoning or burn before attempting to control or clean up the spill.

Herbicide Spill Kit

- Instructions for spill cleanup
- Emergency Telephone Numbers - Numbers of Poison Control Centres
- Personal Protective Safety gear
- Agricultural white lime
- Absorbent material: sawdust, sand, activated charcoal, kitty litter or commercial absorbent
- Neutralizing Material: hydrated lime, activated charcoal or neutrasol
- ABC Type Fire Extinguisher
- Shovels
- Large plastic garbage bags
- Dustpan and shopbrush
- Polyethylene or plastic tarp
- Flagging and Rope
- Herbicide First Aid Kit

BASIC PROCEDURES FOR HANDLING HERBICIDE POISONING, SPILLS AND FIRES *(CONTINUED)*

Procedure for Handling Herbicide Spills and Leaks

- Give first aid if needed.
- Observe fire and explosion hazards and safety precautions before and during clean-up.
- Stop the source of the spill (a leaking tank etc.) quickly. Separate leaking from non-leaking containers.
- Ensure that containers are in upright position; close leaking valves or hoses.
- Transfer leaking containers or their contents to plastic-lined drums or other non-leaking containers.
- Use the B-A-N system (Barricade, Absorb, Neutralize). Barricade or dike the spilled herbicide with soil to prevent its spread, especially into streams, lakes, ponds and other water sources.
- Do not hose down the area. For dust or powder material dampen it with fine water spray and cover it with a tarp.
- Absorb or soak up as much liquid material as possible. Spilled herbicides should be covered with double their volume of absorbent material such as clay soil, hydrated lime, vermiculite, non-chlorinated pet litter, or other commercial absorbents. Flammable materials such as sawdust, rags, and paper are less desirable.
- For spills on impervious surfaces, collect contaminated absorbent, place in plastic lined metal drum and dispose of according to federal and provincial laws and regulations.
- Neutralize any remaining residues and contaminated tools, vehicle etc., with a solution consisting of 1 litre sodium hypochlorite (bleach) plus 1 cup detergent in 8 litres water; or 5 percent sodium carbonate (washing soda) solution plus detergent; or 5 percent trisodium phosphate (TSP) solution plus detergent. Scrub equipment thoroughly and follow with a clean water rinse.

Caution:

- Do not use bleach to treat acidic pesticides such as glyphosate. Dangerous chlorine gas is given off when bleach is mixed with acidic materials.
- If there are large amounts of contaminated material, use a mechanized loader to minimize human contact.
- Carry contaminated material to disposal site in tightly sealed containers.
- Soil contaminated with herbicides should be scraped to a depth of 15 cm and covered with uncontaminated soil.
- The disposal site should be according to regulations, away from ground or surface water and well above the water table.

Handling Herbicide Fires

- Evacuate people and domestic animals, especially those in the downwind of the fire.
- Notify the Fire Service of the herbicide fire. Follow notification procedure above. Ensure to specify the name of the herbicide involved to help them in choosing the appropriate fire fighting clothing and equipment.
- Ask the Fire Service to notify other appropriate emergency services
- Notify the authorities of your company/agency
- Direct the fire fighters on arrival to the location of the fire
- Ensure that all equipment is cleaned-up after fighting the fire
- Check fire fighting personnel for pesticide related poisoning symptoms

References:

Herbicide Spill Kit
Adams, R.W., 1995. Handbook for Pesticide Applicators and Dispensers. Pesticide Control Branch, B.C. Ministry of Environment and Parks, Victoria, B.C. 253 pp.

Procedures for Herbicide Spills
U.S. Forest Service 1979. Final Environmental Statement. Silvicultural Treatments with Herbicides. North Idaho National Forests. U.S.D.A. Forest Service 294 pp.

FIRE PROTECTION/FIRE FIGHTING INFORMATION FOR SELECTED HERBICIDE PRODUCTS

Prevent water used in fire fighting from entering water supplies.

	Asulox F (Asulam)	**Esteron 600® 2,4-D Ester 600® (2,4-D Ester)**	**Formula, 40®F (2,4-D amine)**	**Weedone ®CB (2,4-D/2,4-DP Ester)**	**Glowon® (M.S.M.A.)**
FLASH POINT	Nonaqueous	171° C	89° C (TCC)[a]	70.6°C (TCC)	Not applicable
EXPLOSION/ UNUSUAL FIRE HAZARDS & HAZARDOUS COMBUSTION PRODUCTS	Non-combustible but may give rise to dangerous fumes if strongly heated	May boil, then burn. Noxious fumes (HCl) under fire conditions.	May boil, then burn. Noxious fumes (HCl) under fire conditions.	Hydrogen chloride, phosphorus oxides, carbon monoxide and other chlorine compounds	Arsine gas and other hazardous substances
EXTINGUISHING MEDIA	Watermist, foam, CO_2, dry powder, (soft stream of water [fog or foam] preferred to strong jets)	Water fog, foam (alcohol resistant AFFF at 3% or 6%), CO_2, dry chemical	Water fog, foam, CO_2, dry chemical	Water fog, foam, CO_2, dry chemical	Dry chemical, foam, CO_2, water spray or fog
SPECIAL FIRE FIGHTING/EQUIPMENT PROCEDURE	Wear protective clothing and breathing apparatus	Wear positive pressure self-contained breathing apparatus	Wear positive pressure self-contained breathing apparatus	Wear positive breathing apparatus	Wear self-contained breathing apparatus

FIRE PROTECTION/FIRE FIGHTING INFORMATION FOR SELECTED HERBICIDE PRODUCTS *(CONTINUED)*

	Release® (Triclopyr)	**Tordon® 22K (Picloram)**	**Velpar L® (Hexazinone)**	**Vision® (Glyphosate)**	**Princep® Nine-T Simazine® 80W (Simazine)**
FLASH POINT	64°C (TCC)	101°C	23° C	>93° C	Not applicable
EXPLOSION/ UNUSUAL FIRE HAZARDS & HAZARDOUS COMBUSTION PRODUCTS	Product is combustible. Toxic irritating vapours may be created under fire conditions. Hazardous products: hydrogen chloride, nitrogen oxides and phosgene.	Toxic irritating vapours may be created under fire conditions.	Flammable liquid.	None.	Fire may produce smoke containing hazardous compounds.
EXTINGUISHING MEDIA	Water fog, foam (AFFF[b] at 3% or 6%), CO_2, dry chemical.	Water fog, alcohol resistant AFFF, CO_2, dry chemical.	Water spray, foam, CO_2, dry chemical.	Water spray (avoid splashing), foam, dry chemical, CO_2, or any Class B extinguishing agent.	Dry chemical, foam, CO_2.
SPECIAL FIRE FIGHTING/EQUIPMENT PROCEDURE	Wear positive pressure, self-contained breathing apparatus and full turn-out gear.	Wear positive pressure, self-contained breathing apparatus and full turn-out gear.	Wear self contained breathing apparatus. Use water spray cool tank/container with spray. If heavily exposed to fire and if conditions permit let fire burn itself out since water may increase contamination hazard.	Exposure to vapour or products of combustion: - wear self contained breathing apparatus and full protective clothing. spray. If heavily exposed - equipment should be cleaned after use.	Wear protective clothing and self-contained breathing apparatus.

a TCC: Tagliabue Closed Cup flash tester; b AFFF: Aqueous Film Forming Foam
Sources: Manufacturers Material Safety Data Sheets.

SECTION H

TABLES OF CONVERSION UNITS

CONVERSION FACTORS

Multiply	by	To obtain
LENGTH		
inches	25.40	millimetres (mm)
inches	2.54	centimetres (cm)
feet	30	centimetres (cm)
feet	0.3048	metres (m)
yards	0.9	metres (m)
rod	5.03	metres (m)
chain	20.117	metres (m)
miles (statute)	1.609	kilometres (km)
miles (nautical, international)	1.852	kilometres (km)
AREA		
square inches	6.452	square centimetres (cm^2)
square feet	0.092	square metres (m^2)
acres	4046.7	square metres (m^2)
acres	0.4047	hectares (ha)
VOLUME		
teaspoon (tsp)	4.93	cubic centimetres (cm^3)
tablespoon (tbs.)	14.79	cubic centimetres (cm^3)
cup (U.S.)	236.6	cubic centimetres (cm^3)
fluid ounces (imperial)	28.41	millilitres (ml)
fluid ounces (imperial)	0.96	fluid ounce (U.S.)
fluid ounces (U.S)	29.57	millilitres (mm)
pints (imperial)	0.57	litres (L)
pints (imperial)	1.2	pints (U.S.)
quarts (imperial)	1.1	litres (L)
quarts (imperial)	1.2	quarts (U.S.)
gallons (imperial)	4.546	litres (L)
gallons (U.S.)	3.785	litres (L)
gallons (imperial)	1.2	gallons (U.S.)
bushel (imperial)	36368.7	millilitres (ml)
bushel (U.S.)	35239.1	millilitres (ml)
square feet per acre	0.23	square metres per hectare
cubic feet per acre	0.07	square metres per hectare
cubic yard per acre	1.90	cubic metres per hectare
MASS		
ounces (avoirdupois)	28.35	grams (gm)
pounds (avoirdupois)	0.454	kilograms (kg)
short tons	0.907	metric tons (t)
long tons	1.016	metric tons (t)
metric tons	1000	kilograms (kg)

CONVERSION FACTORS *(CONTINUED)*

Multiply	by	To obtain
TEMPERATURE		
(°F-32°)	0.56	degrees Celsius (°C)
degrees Fahrenheit (°F)	0.56(°F - 32)	degrees Celsius (°C)
degrees Celsius (°C)	(1.8 x °C) +32	degrees Fahrenheit (°F)
t° Kelvin	t° - 273	°C (°Kelvin)
APPLICATION		
pounds per acre	1.12	kilograms per hectare (kg/ha)
RATE		
gal./acre(Imperial)	11.2	litres per hectare (L/ha)
U.S. gal./acre	9.35	litres per hectare (L/ha)
metric tons/acre	2.24	metric tons/hectare
SPEED		
feet per second	0.3	metres per second (m/S)
miles per hour (mph)	1.609	kilometres per hour (km/h)
PRESSURE		
pounds per square inch (p.s.i.)	6.9	kiloPascals (kPa)
bars	0.987	atmospheres (atm)
bars	0.0001	Joules per kilogram (J kg-1)
bars	100	kilo Pascals (kPa)
pascals	1	newtons per square metre (N/m^2)
FLOW RATE		
U.S. gallons/hour (gph)	3.785	litres/hour (L/h)
U.S. gallons/min. (gpm)	3.785	litres/min. (L/m)
Imperial gallons/hr (gph)	4.545	litres/hour (L/h)
Imperial gallons/min. (gpm)	4.545	litres/min. (L/m)
OTHER CONVERSION FACTORS:		

Linear Unit	LINEAR UNITS—EQUIVALENTS						
	Micron	Mil	Milli-meter	Centi-meter	Inch	Foot	Meter
Micron	•	0.039	0.001	$1.0x10^{-4}$	$3.94x10^{-5}$		
Mil	25.4	•	$2.54x10^{-2}$	$2.54x10^{-3}$	0.001	$8.33x10^{-5}$	
Millimeter	1000	39.4	•	0.10	0.0394	$3.28x10^{-3}$	0.001
Centimeter	10000	394	10	•	0.394	0.033	0.01
Inch	$2.54x10^{4}$	1000	25.4	2.54	•	0.083	0.0254
Foot	$3.05x10^{5}$	$1.2x10^{4}$	305	30.5	12	•	0.305
Meter	$1.0x10^{6}$	$3.94x10^{4}$	1000	100	39.4	3.28	•

Liquid Pressure	LIQUID PRESSURES—EQUIVALENTS						
	Lb/In^2 (p.s.i.)	Ft Water	Kg/Cm^2	Atmo-sphere	Bar	Inch Mercury	kPa (kilopas-cal)
Lb/In^2 (p.s.i.)	•	2.31	0.070	0.068	0.069	2.04	6.895
Ft Water	0.433	•	0.030	0.029	0.030	0.882	2.99
Kg/Cm^2	14.2	32.8	•	0.968	0.981	29.0	98
Atmosphere	14.7	33.9	1.03	•	1.01	29.9	101
Bar	14.5	33.5	1.02	0.987	•	29.5	100

Volumetric Unit	VOLUMETRIC UNITS—EQUIVALENTS						
	Cubic Centi-meter	Fluid Ounce	Pound of Water	Liter	US Gallon	Cubic Foot	Cubic Meter
Cubic Centimeter	•	0.034	$2.2x10^{-3}$	0.001	$2.64x10^{-4}$	$3.53x10^{-5}$	$1.0x10^{-6}$
Fluid Ounce	29.6	•	0.065	0.030	$7.81x10^{-3}$	$1.04x10^{-3}$	$2.96x10^{-5}$
Pound of Water	454	15.4	•	0.454	0.12	0.016	$4.54x10^{-4}$
Liter	1000	33.8	2.2	•	0.264	0.035	0.001
US Gallon	3785	128	8.34	3.785	•	0.134	$3.78x10^{-3}$
Cubic Foot	28320	958	62.4	28.3	7.48	•	0.028
Cubic Meter	$1.0x10^{6}$	$3.38x10^{4}$	2202	1000	264	35.3	•

Sources: Spraying Systems Co. Industrial Catalog #27

Notes: